SAN FRANCISCO CLEAN WATER PROGRAM

# Mariposa Transport/Storage Facilities
# Project Report
# Amendment to the Bayside Facilities Plan
## (March 1982)

**September 1983**


SUBMITTED BY

CITY AND COUNTY OF SAN FRANCISCO
DEPARTMENT OF PUBLIC WORKS
CLEAN WATER PROGRAM

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## MARIPOSA TRANSPORT STORAGE FACILITIES PROJECT REPORT


### Abstract

In March 1982, the San Francisco Clean Water Program published the Bayside Facilities Plan - North Bayside Project Report; it included the Mariposa Transport Storage Facilities required to reduce combined sewage overflows to the bay. None of the facilities recommended in the report were implemented because of a lack of Federal grant funds and the scheduling of other water pollution control projects.

This Report Amendment develops additional alternatives to reduce overflows, including tunnels and in-line storage. It analyzes and compares these alternatives and recommends an Apparent Best Alternative.

The Apparent Best Alternative recommended herein consists of a large transport storage sewer located in a public street with submersible wet weather pumps located in the sewer, a refurbished Mariposa dry weather pump station, a package 20th Street pump station, new force mains and new gravity sewers.

The background information required for a Facility Plan is contained in a separate Background Report Amendment to the original 1982 Background Report. The reader is urged to read the pertinent report for a full understanding or, at least, the Summary and Recommendations, Chapter 2 of the March 1982 Bayside Facility Plan - north Bayside Project Report. The reproduced summary is contained in Appendix A for ready reference.

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# CHAPTER 1

# INTRODUCTION

## BACKGROUND

In 1982, a Bayside Facilities Plan, North Bayside Project Report was prepared by the San Francisco Clean Water Program to develop and analyze alternatives which would reduce the number of combined sewage overflows from the Mariposa drainage area from approximately 46 per year to an average of 10 per year. The City is preparing to go forward with this project. However, the Environmental Protection Agency regulations require updating of Facility Plans more than five years old. The purpose of this report is to update the work done previously and to reconfirm the previous Apparent Best Alternative or to recommend a new Apparent Best Alternative.

Several final alternatives for Mariposa were analyzed in the 1982 report. These consisted of a pumping station and storage in a detention reservoir near the existing Mariposa Pump Station or in an in-line storage box sewer structure under China Basin Street. Flows from the Mariposa area would be initially transported north to the Channel Basin or south to the Islais Creek Basin and ultimately to the Southeast Water Pollution control Plant for treatment and disposal.

An Apparent Best alternative (ABA) was recommended; this alternative included a 1.5 million gallon wet-weather storage reservoir, a new 5 mgd wet-weather pump station, and use of the existing Mariposa Pump Station for dry-weather flow. Wet-weather flow was to be transported south to the Third Street sewer at 23rd Street via a force main located in Illinois Street and in 23rd

Street. For the Twentieth Street subbasin, a 0.06 million gallon, in-line, transport/storage facility, utilizing the existing 0.39 MGD pump was recommended.

NEW PLANNING EFFORTS

Tunnel alternatives were briefly considered in 1982 but rejected from inclusion to the report because the tunneling cost estimates were very high. Since then tunneling technology has become more advanced; and consequently, tunneling project costs are now much lower. Thus it was decided that gravity wet-weather solutions should now also be considered for the Mariposa Project in addition to transport/storage pumping alternatives. As a result, five tunnel alternatives were developed with various alignments along Illinois Street, Third Street and Indiana Street from Mariposa to Army (T1A, T2A, T1B, T2B, T3). Alignments were chosen along these streets so that present wet-weather flow to Third Street could be picked up directly by the tunnel. This would have the additional benefit of alleviating the need to replace current inadequate sewers on Third Street.

The original 1982 ABA was slightly modified with respect to reservoir and force main size and is discussed within this report as Alternative 1. Additionally, another review was made of the feasibility of constructing a transport/storage box within public streets in order to avoid acquisition of private property whose value is rising because of its proximity to the 300 acre Mission Bay Project. This solution, Alternative 2, is essentially the same as

Alternative 1, except that the storage facility will be a box structure underneath Mariposa Street between Third and Illinois Streets instead of a reservoir situated on private property.

The Twentieth Street subbasin was re-analyzed and it now includes a 50-acre storm and sanitary drainage area instead of the original 9-acre drainage area. Due to this change, the original transport/storage facility discussed in the 1982 report is no longer adequate, and three new alternatives were developed. These solutions include one gravity and two pumping Alternatives G-1, P-1, P-2 respectively.

Because of the additional planning and study efforts discussed above, an amendment to the Mariposa Transport/Storage Project Section of the 1982 Bayside Facilities Plan, North Bayside Project Report has been developed and is presented in the following chapters as an update to the 1982 report. The proceeding sections analyze and compare the seven Mariposa alternatives and the three new Twentieth Street alternatives and ultimately define an Apparent Best Alternative for the Mariposa and the 20th Street subbasins.

## CHAPTER 2

## SUMMARY AND RECOMMENDATIONS

The Mariposa Transport Storage Project was originally addressed in the Bayside Facility Plan, North Bayside Project Report. Since the report was completed in 1982 and is more than 5 years old, this report was prepared to comply with the Environmental Protection Agency grant requirements that Facility Plans more than 5 years old must be updated before implementation.

This report reviews the previous work in the 1982 report; adds additional alternatives, including the use of tunnels as gravity solutions; considers additional areas for storm water control; analyzes and compares the Best Apparent Alternative of the 1982 report (modified as appropriate) with the newly developed alternatives and recommends the implementation of the resulting Apparent Best Alternative (ABA).

The reader is referred to the Background Report of the previous 1982 Facility Plan and to the current Background Report Addendum, which includes an update of the background information contained in the 1982 report.

The 1982 report Apparent Best Alternative included a reservoir at an off-street site near the existing Mariposa Pump Station and the continued use of the Mariposa dry weather pump station. Also as part of the Apparent Best Alternative, the 20th Street sub-basin was to continue the use of the existing 20th Street pump station with the addition of storage underneath the street.

In this report, the previous ABA was compared with newly developed alternatives. The concept of tunnels was introduced and rejected because of their higher cost. The reservoir concept gave way to in-street storage, the Mariposa service area was altered and the 20th Street sub-area was enlarged to take care of existing storm discharges that were not addressed in the 1982 Planning effort.

In summary, the Apparent Best Alternative recommended herein is as follows:

Mariposa Tributary Area

Construction of an in-line storage box sewer containing wet-weather pumps in Mariposa Street beginning at the easterly line of 3rd Street and extending to the existing Mariposa Pump Station site. A force main directs wet-weather flow from the box to a new sewer in Illinois Street beginning at 21st Street extended. Dry-weather flow would continue to be pumped by the existing upgraded Mariposa Pump Station.

20th Street Subbasin

Two Best Apparent Alternatives are offered, with the choice depending upon the feasibility of constructing facilities within Port property. One alternative can be constructed completely within public street area (20th Street). It includes in-line storage upstream of a new underground pump station, pumping to a new sewer in Illinois Street at 21st Street extended. The Port of San Francisco would, in the future, be required to construct facilities to bring storm water flows from Port property to the storage facility.

The Alternative ABA for this sub-basin proposes a new pump station closer to the shoreline in Port property and utilizes storage in a sewer required to be constructed to collect stormwater discharge from a 24-inch diameter storm sewer. Cooperation would be required from the Port to implement this alternative. The primary advantage of this alternative is overall cost savings to the City and storm discharges (as opposed to combined sewage) now going to the Bay would be intercepted.

# CHAPTER 3

## DEVELOPMENT OF ALTERNATIVES

Facilities are to be constructed to reduce the number of overflows from the Mariposa drainage area from approximately 46 per year to an average of 10 per year. To accomplish this overflow reduction, a wet-weather storage facility and an increase in wastewater transport rate from both the Mariposa and Twentieth Street subbasins will be used. However, the sewer capacity will not be increased.

### Facility Sizing Update

The rate of flow and the quantity of flow is slightly different from the Master Plan for the following reasons:

An analysis of transport and storage trade-offs, see Appendix A, was conducted for both the Mariposa and the Twentieth Street subbasins. The tributary area to the Mariposa subbasin was calculated to be 220.3 acres. In determining a run-off coefficient for this subbasin, the future development of the newly proposed Mission Bay Plan area within the Mariposa drainage area (40 acres) was considered. Mission Bay encompasses about 300 acres under private ownership near the shoreline of SF Bay within the City and County of San Francisco. The site is bounded by Townsend Street on the northwest, Mariposa Street on the south, Seventh Street on the southwest and Port of San Francisco administered land to the east.

The plan for this site calls for a new urban neighborhood with an integrated living and working environment to be built over the next 20 to 30 years along with a system of parks, recreation and natural resource areas.

The southern 40 acres of the Mission Bay Project is contained within the Mariposa subbasin. See Fig. 3-1. The Mission Bay plan which depicts optimum development, was analyzed in order to determine the amount of additional stormwater run-off which would be generated within the Mariposa subbasin and what effect it would have on the Mariposa Transport/Storage Project.

After study and review, it was determined that run-off generated by the Mission Bay Project within the Mariposa subbasin would be higher than that presented by the San Francisco Master Plan for Wastewater Management. The original weighted run-off coefficient of 0.65, which was used in the Master plan was increased to 0.67; thereby, requiring additional storage and/or pumping, to meet overflow requirements. After analysis, it was concluded that a pumping rate of 6 MGD and a storage volume of 1.30 MG would be the best combination to economically meet the required overflow criteria.

The tributary area to the Twentieth Street subbasin was re-analyzed and it was determined that the subbasin should be increased from 9 acres, which was used in the 1982 study, to 50.7 acres, to intercept storm sewers from areas where the surface runoff could be a source of pollution. Since this drainage area is almost entirely paved, a run-off coefficient of 0.9 was established. After analysis of the various storage/pumping combinations, it was determined that the appropriate facility sizing for the Twentieth Street

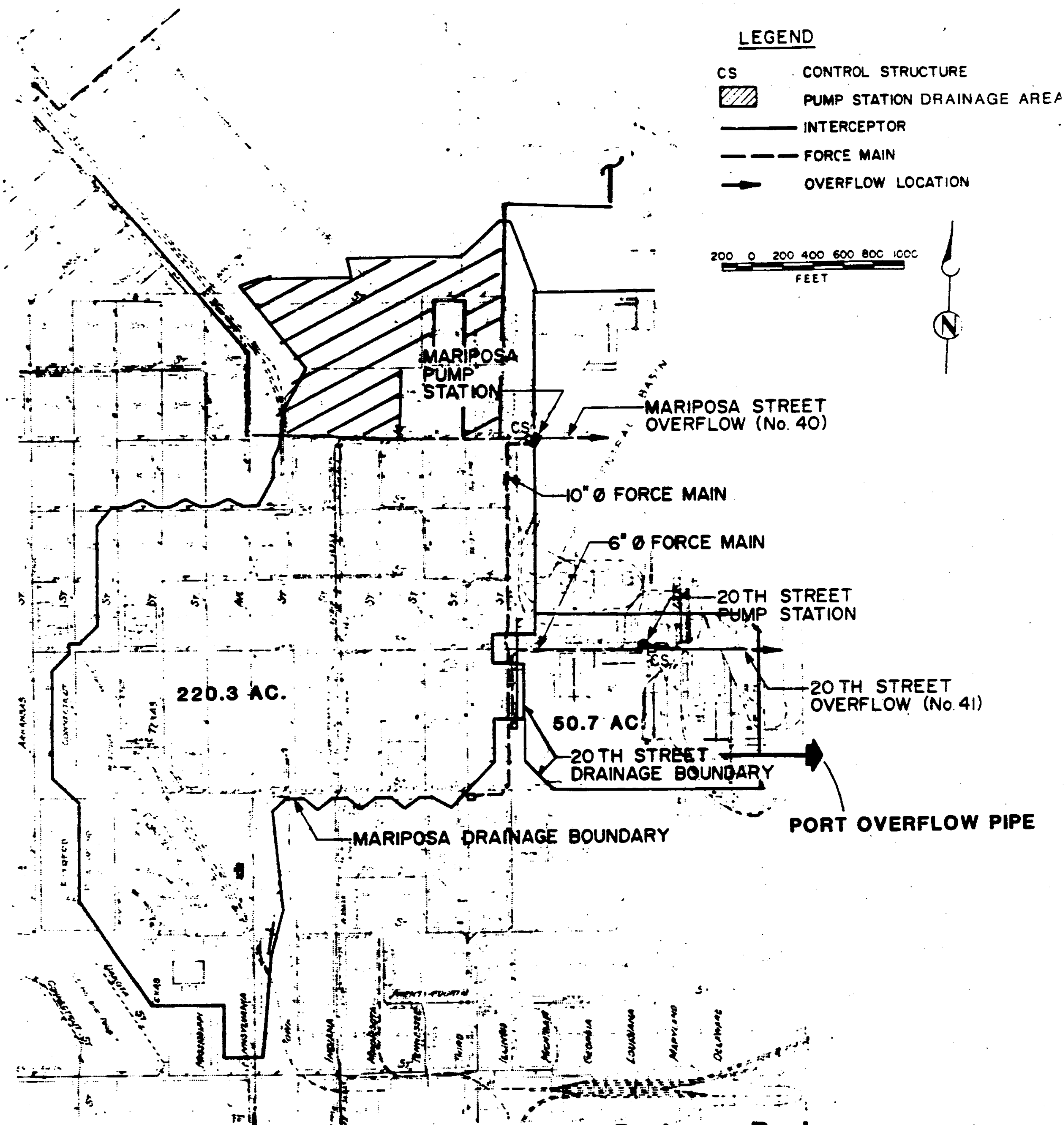



**Figure 3-1 Mariposa Drainage Basin Mission Bay Overlap**

subbasin area was a pumping rate of 3 MGD and a storage volume of 0.175 MG the storage/pumping combinations are shown below (See Appendix B):

| Alternative No. | Pumping Rate (MGD) | Storage (MG) |
|---|---|---|
| 1 | 1 | 0.5 |
| 2 | 2 | 0.3 |
| 3 | 3 | 0.175 |

Mariposa Transport/Storage Alternatives

Five gravity and two pumping scenarios were developed to reduce the number of overflows from the Mariposa drainage area; these are presented below.

ALTERNATIVE T-1A

Under this tunnel alternative, both the Mariposa and 20th Street pump stations would be eliminated. The dry-and wet-weather flows in the Mariposa drainage area would be transported to the Islais Creek Transport/Storage Facility by gravity through a 9 ft. diameter tunnel.

A 9 ft. diameter tunnel with approximately 3 MG capacity of storage would be constructed in Third Street from Mariposa to Army Street, where it would proceed westward underneath a railroad easement just south of the southern property line of Army Street, and connect to the proposed Islais Creek T/S Facilities at Indiana and Army Street.

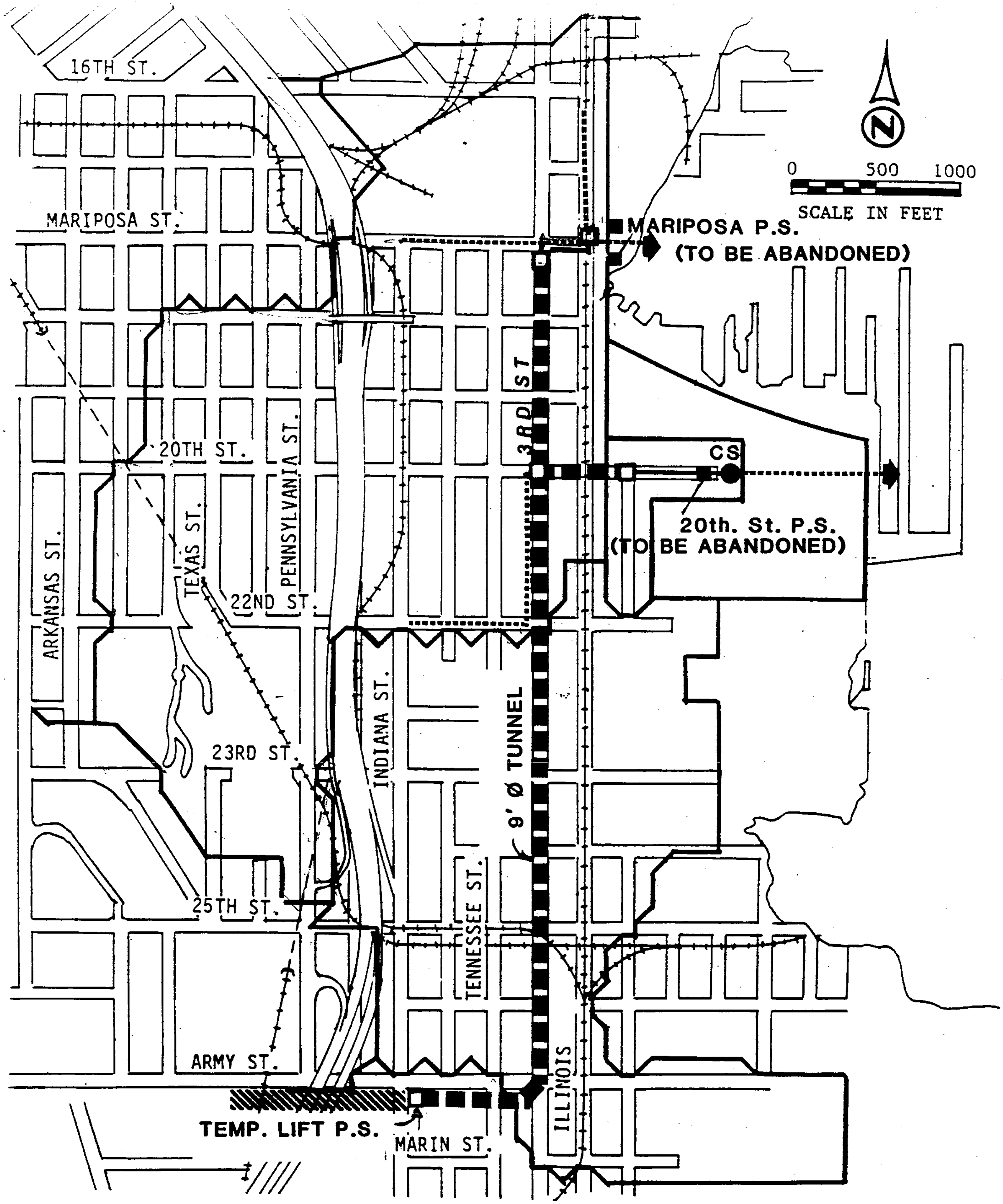
Both dry-and wet-weather flows from upstream of Mariposa and Illinois Streets would be diverted into the tunnel by 48" and 72" diameter pipes at Mariposa and at Third Street, respectively. As the tunnel proceeds south along Third Street, it would intercept existing flows from a 3.5' x 5.25' sewer and a proposed 9 ft. diameter tunnel along 20th St. draining the lower part of the 20th St. sewer.

It is possible that the Islais Creek T/S Facilities would not be ready to accept the Mariposa flows when the proposed tunnel is completed. A temporary 5.5 MGD lift pump station located at Army and Indiana Street then would have to be incorporated into this alternative to provide short term transport of the Mariposa flows to an existing sewer line leading into the SEWPCP. See Fig. 3-2.

ALTERNATIVE T-1B

This tunnel alternative is similar to Alternative T-1A. Both Mariposa and 20th Street pump stations will be eliminated and a temporary 5.5 MGD lift pump station may be required, but it has a slightly different alignment from Alt. T-1A.

Under this alternative, the 9 ft. diameter tunnel is to begin at Illinois and Mariposa Street and proceed south on Illinois Street. It turns to Third Street at 22nd Street and proceeds south on Third Street until it reaches a point just south of the southern property line of Army Street. From this point, it continues westward until it connects to the proposed Islais Creek T/S Facilities at Indiana and Army Street. Along its route, it will intercept existing flows from a proposed 9 ft. diameter tunnel at 20th and Illinois Street and from an existing 3.5' x 5.25' sewer at 22nd and Third Street. See Fig. 3-3.




LEGEND

- TUNNEL
- ISLAIS CREEK FACILITIES
- INTERCEPTOR
- EXISTING SEWER
- CS CONTROL STRUCTURE
- EXISTING PUMP STATION
- TRANSPORT/STORAGE
- OUTFALL
- JUNCTION STRUCTURE AND TEMPORARY PUMP STATION

**FIGURE 3-2**

**ALTERNATIVE T-1A**

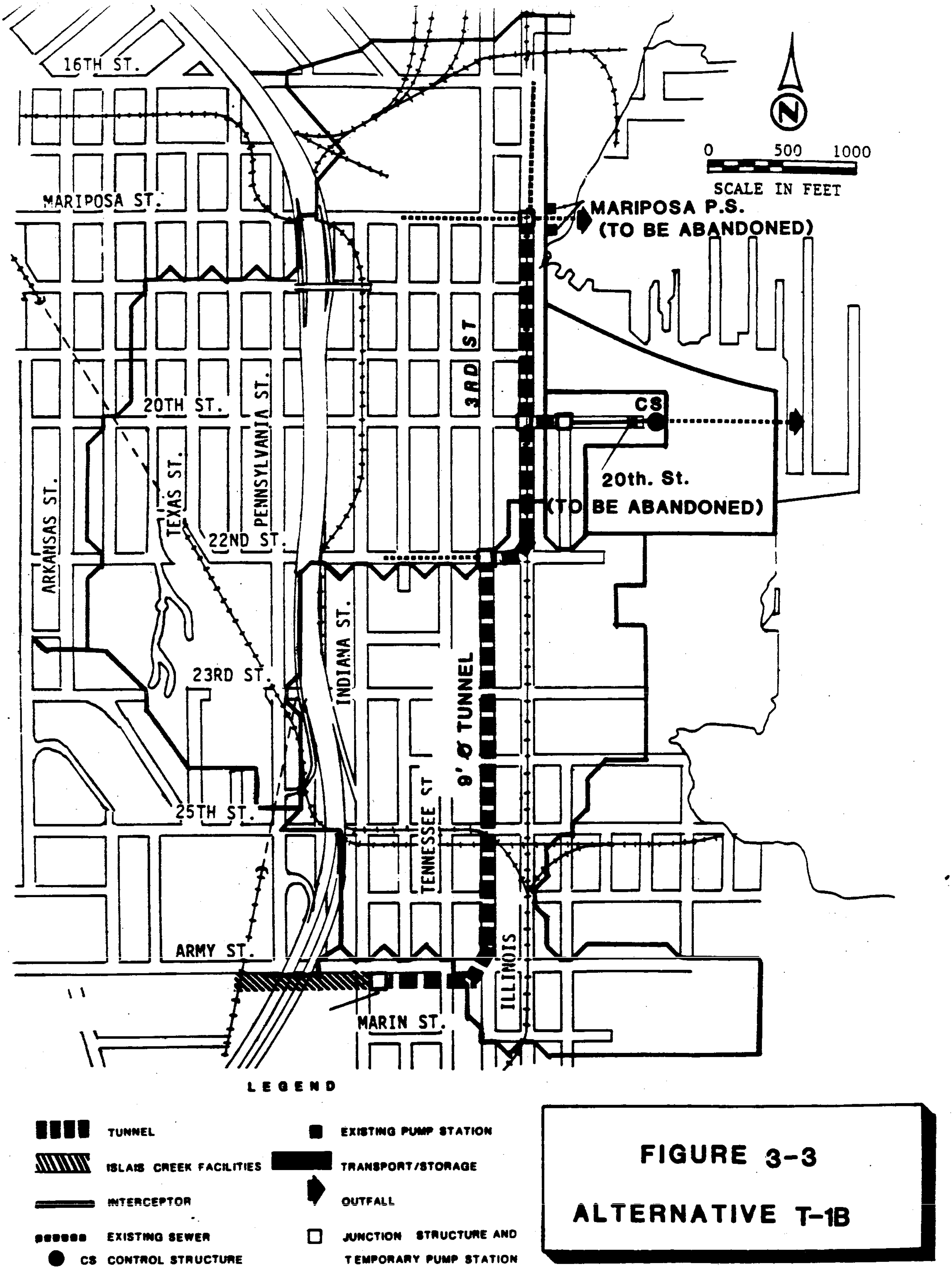



**FIGURE 3-3**

**ALTERNATIVE T-1B**

ALTERNATIVE T-2A

This alternative has the identical alignment as Alternative T-1A. The major difference is that the proposed 9 ft. diameter tunnel on Third and Army Streets is used for transporting wet-weather flow only; therefore, the existing Mariposa Street and 20th Street pump stations will remain for pumping dry-weather flows to the SEWPCP through the existing force mains. The tunnel on 20th Street is eliminated, and an 8 ft. diameter pipe would be installed instead in 20th Street for storage of wet-weather flow in the 20th Street subbasin. After a storm, the stored flow will be routed thru the existing force main to the SEWPCP for treatment. As mentioned in prior alternatives, a temporary 5.5 MGD lift pump station may be required to pump wet-weather flow pending the status of the Islais Creek T/S Facilities Project. See Fig. 3-4.

ALTERNATIVE T-2B

This tunnel alternative has the same alignment as Alt. T-1B. However, the facilities for storing wet-weather flows and pumping dry weather flows are exactly the same as in Alt. T-2A, in which the function of the proposed 9 ft. diameter tunnel is for transporting wet-weather flows only. As discussed earlier, a temporary 5.5 MGD lift pump station may still be required as in Alt. T-1A. See Fig. 3-5.

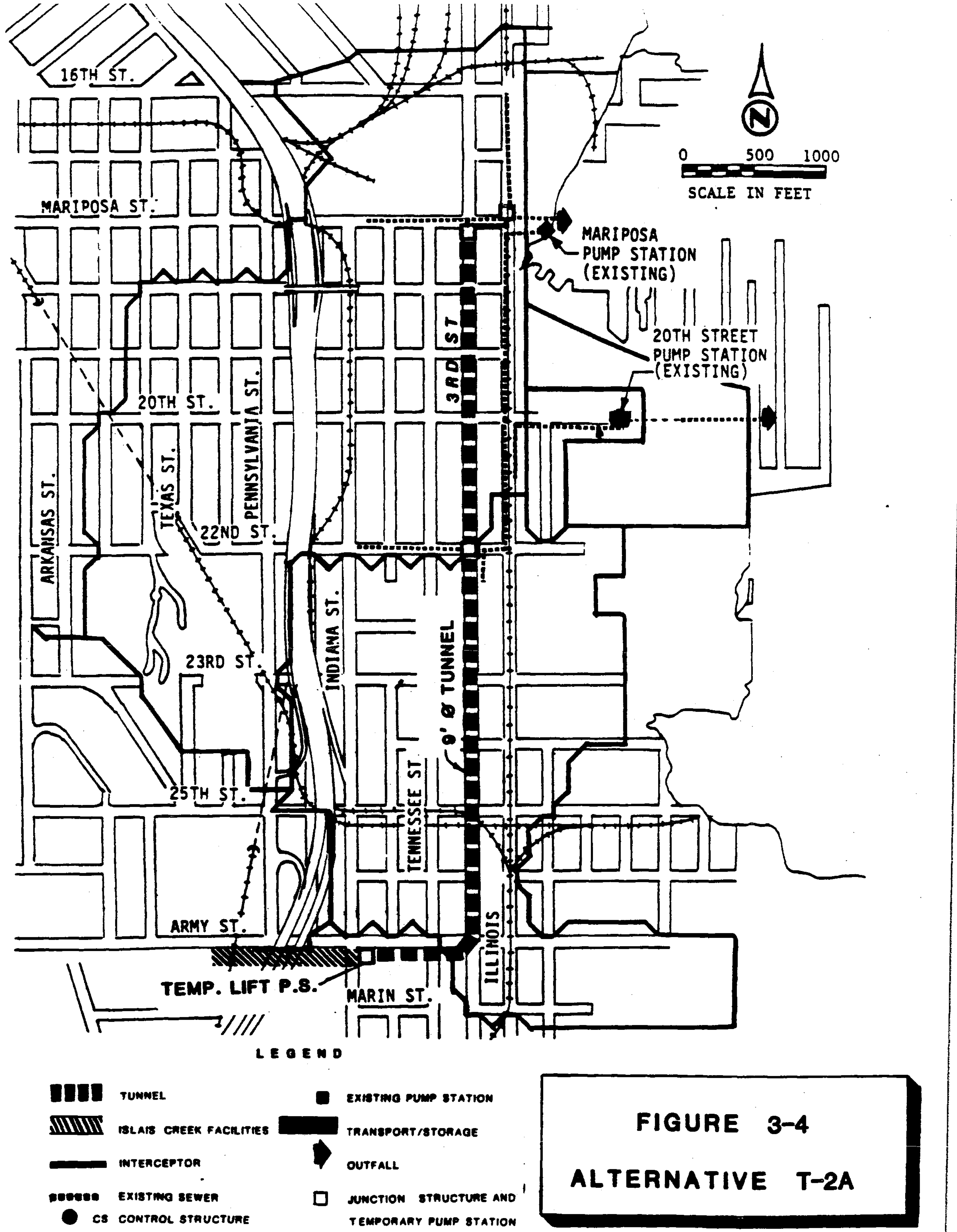



**FIGURE 3-4**

**ALTERNATIVE T-2A**

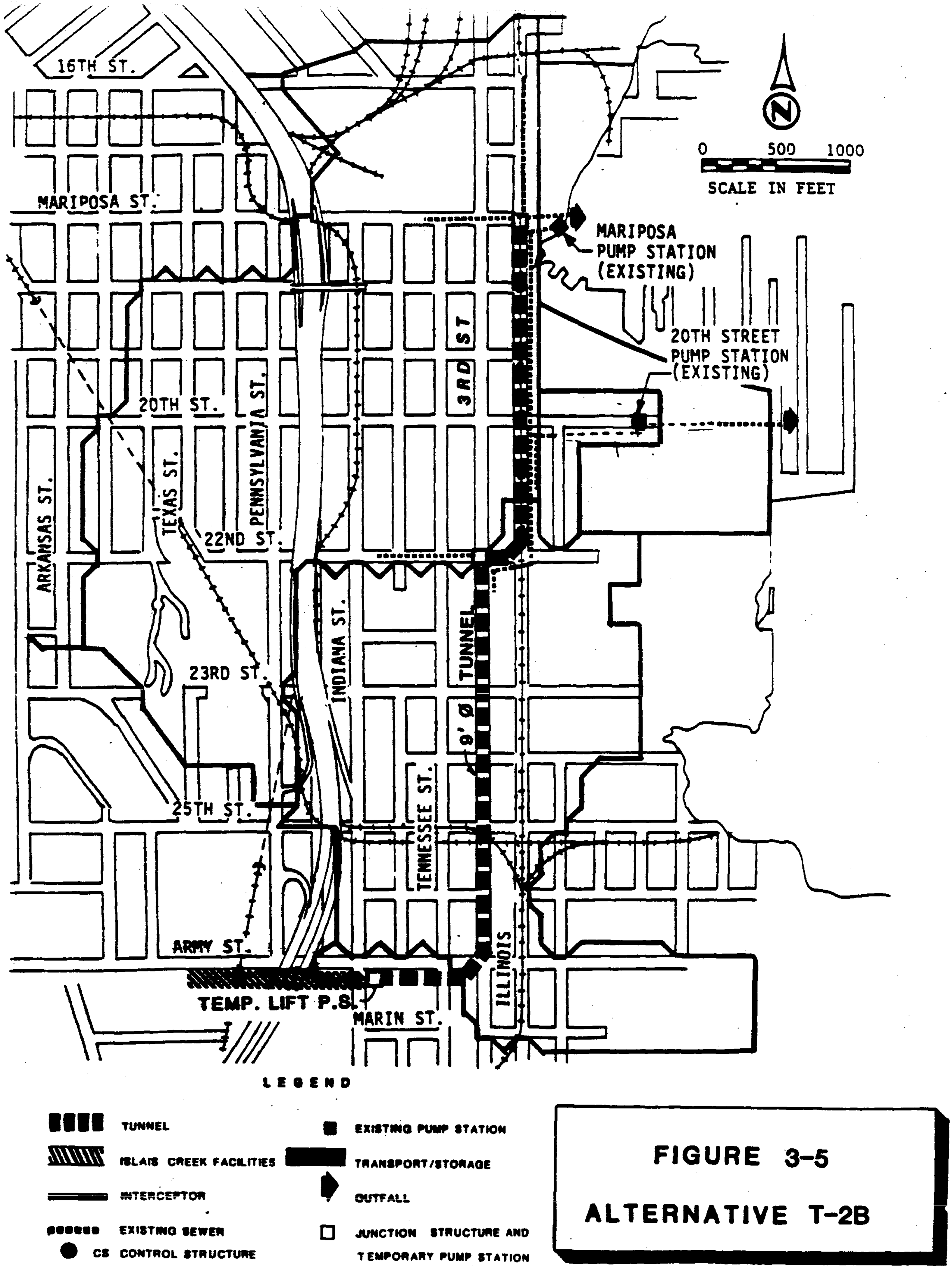



**FIGURE 3-5**

**ALTERNATIVE T-2B**

ALTERNATIVE T-3

Under this tunnel alternative, wet-weather flows in the Mariposa subbasin will be transported down to the Islais Creek Transport/Storage Facilities by gravity through a 9 ft. diameter tunnel.

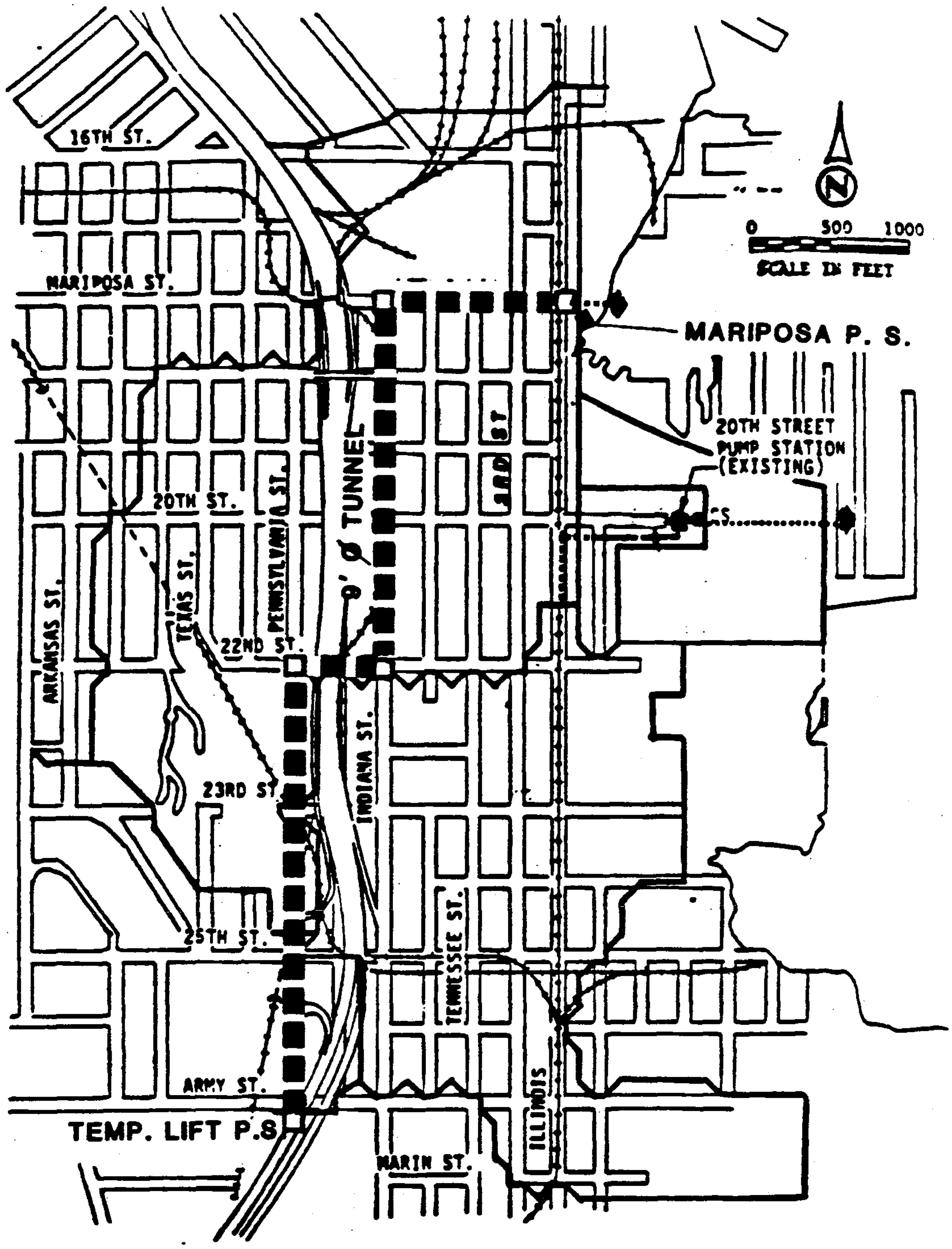
A 9 ft. diameter tunnel with approximately 3 MG capacity of storage is to be constructed along Mariposa St. from Illinois to Indiana, Indiana St. from Mariposa to 22nd, 22nd St. from Indiana to Pennsylvania, and along Pennsylvania St. from 22nd to Army where it will connect to the proposed Islais Creek Transport/Storage Facilities. An 8 ft. diameter pipe would be installed in 20th Street for storage of wet-weather flow. After a storm the stored flow will be routed thru the existing force main to the SEWPCP for treatment.

It is possible that the Islais Creek T/S Facilities may not be ready to accept the Mariposa flows by the time the tunnel is completed. A temporary 5.5 MGD lift station located at the Army St. might have to be incorporated into this alternative to provide short term transport of the Mariposa flows to an existing sewer line leading into the SEWPCP. See Fig. 3-6.

ALTERNATIVE 1: PUMP STATION/RESERVOIR (1982 ABA, MODIFIED).

Proposed Facilities

This alternative was selected in the 1982 planning work as the Apparent Best Alternative (ABA) to provide increased conveyance and storage of wet weather flows prior to treatment at the SEWPCP. Because of a reassessment of the drainage area as described earlier, facility sizes of this 1982 ABA (e.g., storage volume, pumping rate, force main diameter, etc.) have been slightly modified.




INDIANA STREET ALIGNMENT

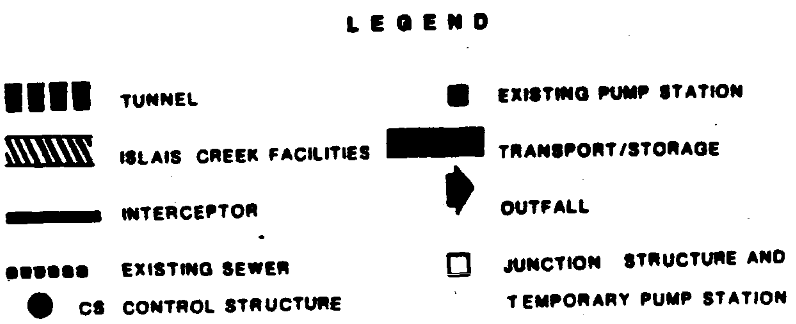



**FIGURE 3-6**

**ALTERNATIVE T-3**

Alternative 1 consists of a new 6 MGD wet-weather Mariposa Pump Station, a new 1.3 MG covered reservoir at the site of the new station, a refurbished 1.35 MGD dry weather pump station, and a new 16-inch diameter wet-weather force main. This alternative would retain and continue to use the existing 10-inch Mariposa force main for dry-weather operation.

The proposed 6 MGD pump station and 1.3 MG covered reservoir would be constructed on a privately owned lot located at the southwest corner of Mariposa and Illinois Streets. The size of the lot is approximately 0.45 acres. The pump station, flushing facility, and odor control facilities would be housed in a structure 24 feet by 100 feet, located on the west side of the site. The 1.3 MG covered and below grade reservoir would consist of four 88 foot by 25 foot basins. The effective storage depth of the reservoir would be 24 feet. Two wet-weather pumps, operating in parallel, would have a pumping capacity of 6.2 MGD. In addition, two new dry wet-weather pumps, one with a capacity of 1.35 MGD and one stand-by, and new electrical controls would replace outdated equipment in the existing Mariposa Pump Station, which would continue to handle dry-weather flows.

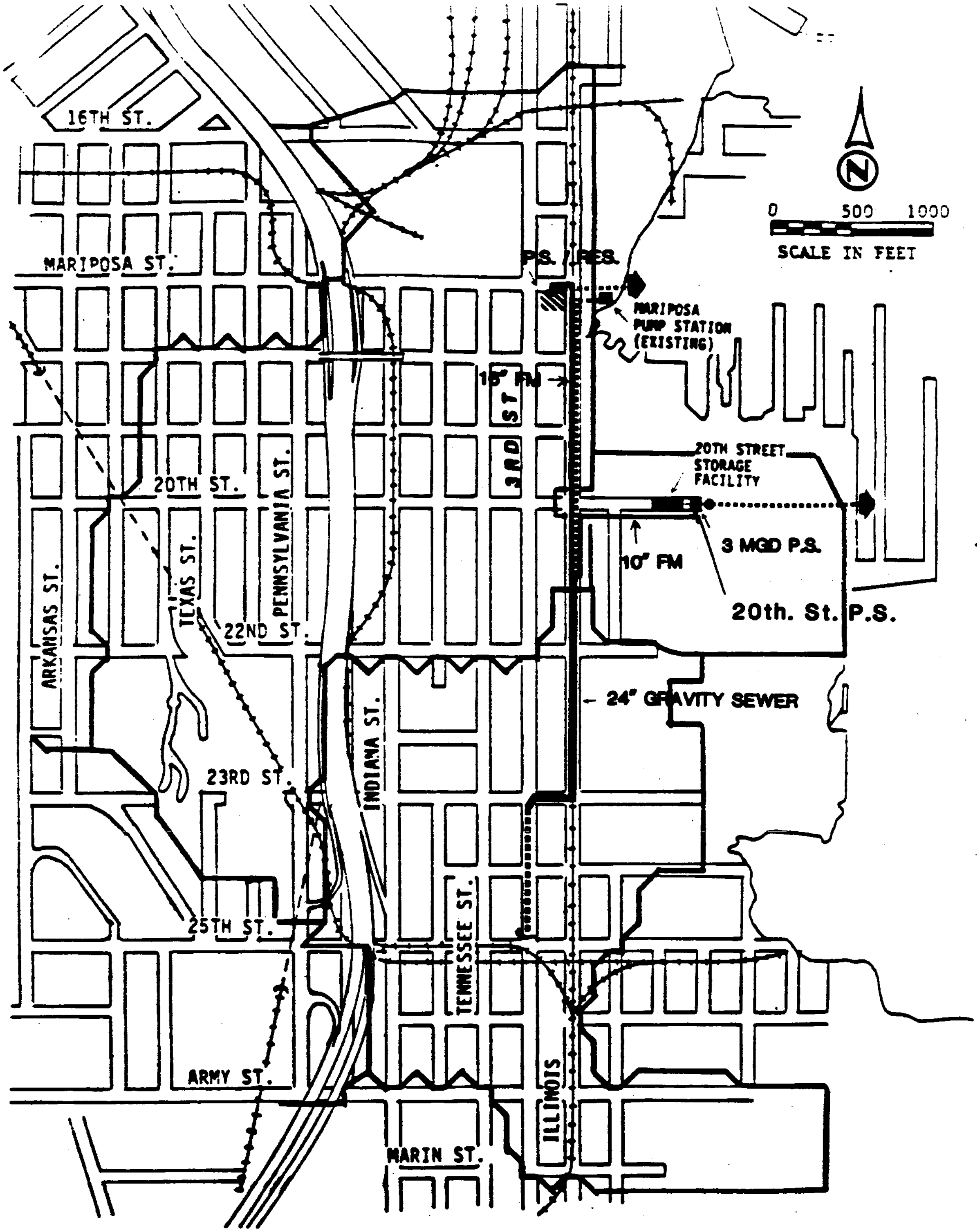
<u>Mariposa Force Main and Sewer</u>. A 1,650 foot long, 16-inch diameter force main and a 1,750 foot long, 24-inch gravity sewer will be constructed to connect the proposed wet-weather pump station (at Illinois and Mariposa Streets) to an existing 3-foot by 4.5-foot sewer at Twenty-Third and Third Streets.

The route of the force main will begin at the wet-weather Mariposa Pump station and proceed southerly along Illinois Street to Twenty-First Street extended. At Twenty-First Street, the force main will connect to a new gravity sewer which will extend southward on Illinois Street to Twenty-Third and westward on Twenty-Third St. to Third St. This 24-inch diameter gravity sewer will also intercept flows from the existing 10-inch Mariposa force main, which will be used for dry weather flows, an existing 6-inch force main and a new 10-inch force main from the new Twentieth Street Pump Station. See Fig. 3-7.

ALTERNATIVE 2: TRANSPORT/STORAGE BOX AND IN-LINE PUMP STATION

Proposed Facilities

A Transport/Storage Box, with dimensions 360 feet long, 22 feet wide, and 22 feet deep would be constructed on Mariposa Street, between Third Street and the existing Mariposa Pump Station. The structure would only collect wet weather flows. A new pumping station would be constructed inside the box and would contain two wet-weather pumps and two small dewatering pumps. The two wet-weather pumps, operating in parallel, would have a pumping capacity of 6.2 MGD. Two new dry-weather pumps, one with a capacity of 1.35 MGD and one stand-by, and new electrical controls would replace outdated equipment in the existing Mariposa Pump Station, which would continue to handle dry-weather flows. Wet weather flow would be pumped through a new 16-inch force main on Illinois Street and then be intercepted by a new



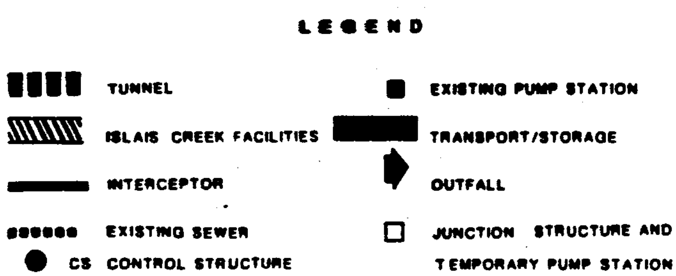




FIGURE 3-7

ALTERNATIVE 1

P.S. / RESERVOIR ALTERNATIVE

24-inch gravity sewer at Twenty-First Street extended. This 24-inch sewer would continue along Illinois Street and connect to an existing 3 foot by 4.5 foot sewer connection at Twenty-Third and Third Streets. Dry-weather flow would be pumped through the existing 10-inch Mariposa force main on Illinois Street to the proposed 24-inch sewer at Twenty-First Street. The 24-inch sewer will also intercept flow from a new 10-inch force main from the Twentieth Street Pump Station. See Fig. 3-8.

The preliminary costs of the various alternatives described above are shown in Table 3-1:

As can be seen from the table, tunnel costs are significantly greater than those for the pumping scenarios. Therefore, only the two pumping alternatives were selected for further analysis.

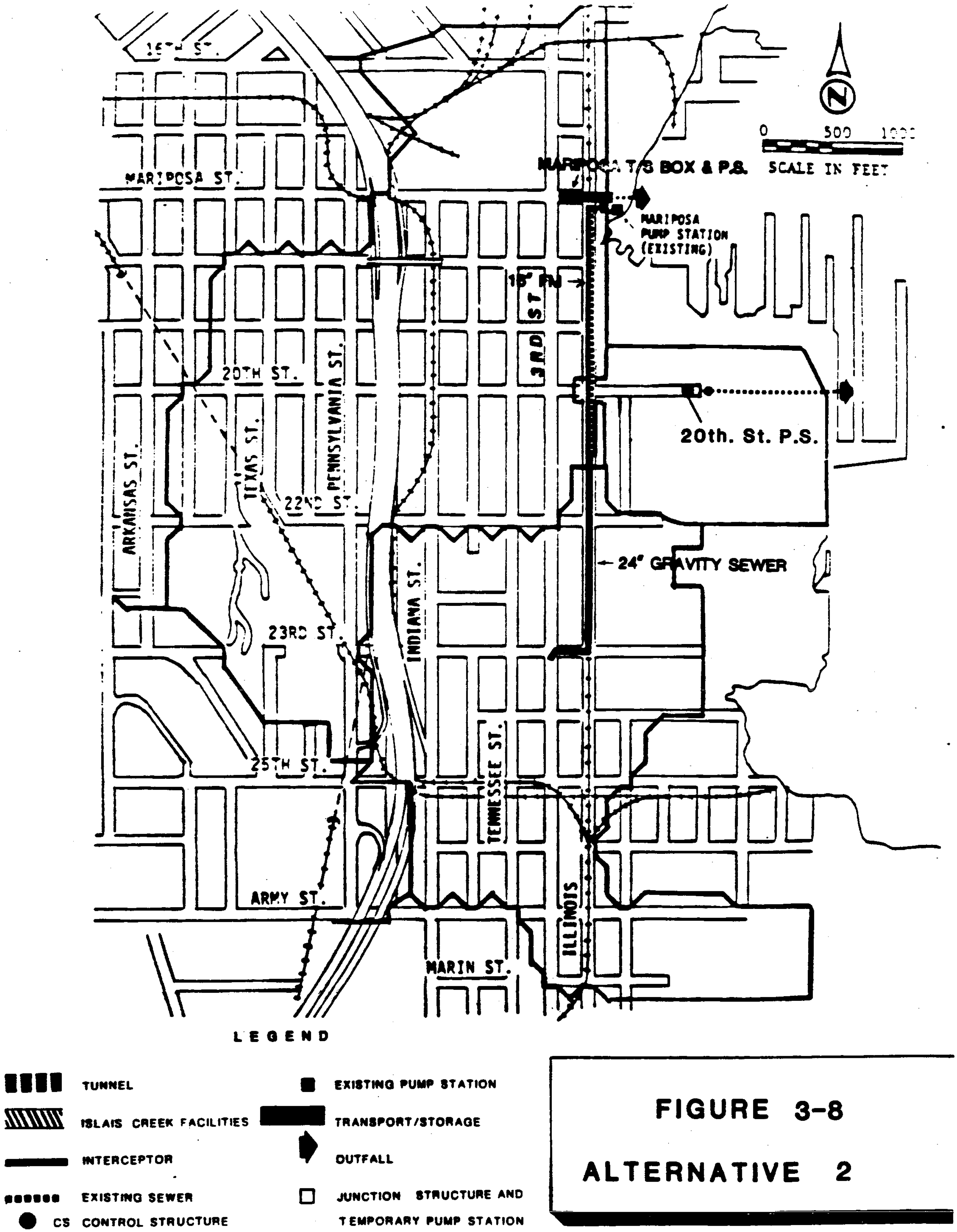



**FIGURE 3-8**

**ALTERNATIVE 2**

**MARIPOSA T/S PUMPING ALTERNATIVE**

TABLE 3-1, MARIPOSA ALTERNATIVES,
Construction Costs
(Million Dollars), ENR5517

| ALT | 1 | 2 | T1A | T1B | T2A | T2B | T3 |
|---|---|---|---|---|---|---|---|
| Structural-Reservoir Transport Storage Or Tunnel | 4.01 | 2.96 | 13.95 | 14.00 | 12.60 | 13.08 | 11.66 |
| WW Pumps | 0.46 | 0.46 | --- | --- | --- | --- | --- |
| DW Pumps | 0.18 | 0.18 | .37* | .37* | .37* | .37* | .37* |
| Flushing | 0.15 | 0.01 | --- | --- | --- | --- | --- |
| Odor Control | 0.06 | 0.08 | --- | --- | --- | --- | --- |
| Force Main & Sewer | 1.10 | 1.16 | .02 | .02 | .02 | .02 | .02 |
| Construction Cost | 5.96 | 4.85 | 14.34 | 14.39 | 12.99 | 13.47 | 12.05 |
| Contingencies 10% Prof. Services 16% | 1.55 | 1.26 | 3.73 | 3.74 | 3.38 | 3.50 | 3.13 |
| Land | .61 | --- | --- | --- | --- | --- | --- |
| Total Capital Cost | 8.12 | 6.11 | 18.07 | 18.13 | 16.37 | 16.97 | 15.18 |
| Annual O&M | 0.07 | 0.07 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 |
| Present Worth O&M | 0.66 | 0.66 | 0.74 | 0.74 | 0.74 | 0.74 | 0.74 |
| Total Present Worth | 8.78 | 6.77 | 18.81 | 18.87 | 17.11 | 17.71 | 15.92 |
| EQUIVALENT ANNUAL TOTAL COST | 0.94 | 0.72 | 2.01 | 2.02 | 1.83 | 1.89 | 1.70 |

*Temporary Pump Station

Twentieth Street Transport/Storage Alternatives

Additional field investigations which indicate that a larger area contributes stormwater runoff to the Bay and new information from the Port of San Francisco, make it necessary to modify the original Twentieth Street solution developed in 1982. As explained under Facility Sizing above, the new size for the 20th St. subbasin should be 3.0 MGD rate and storage of 0.175 mg.

Three new alternatives, one gravity and two pumping, have been developed to reduce the number of overflows from this area and are discussed below.

ALTERNATIVE P-1

In this alternative, a new 3 MGD package pump station would be located at the site of the existing Twentieth Street Pump Station. A new 7'-0" diameter sewer would be located west of the pump station providing .175 million gallons of storage. Flow from storage would be pumped westward on Twentieth Street and Southward on Illinois Street via a new 10-inch force main to a proposed 24-inch gravity sewer to be constructed from Twenty-First and Illinois Streets to Twenty-Third and Third Streets. Flow from the southeast portion of the Twentieth Street drainage area would be transported to the pump station by gravity in new 42-inch and 48-inch diameter sewers. These sewers are proposed future facilities to be constructed by the Port of San Francisco. The Port may or may not construct this or a similar drainage system on its property in the future. See Figure 3-9.

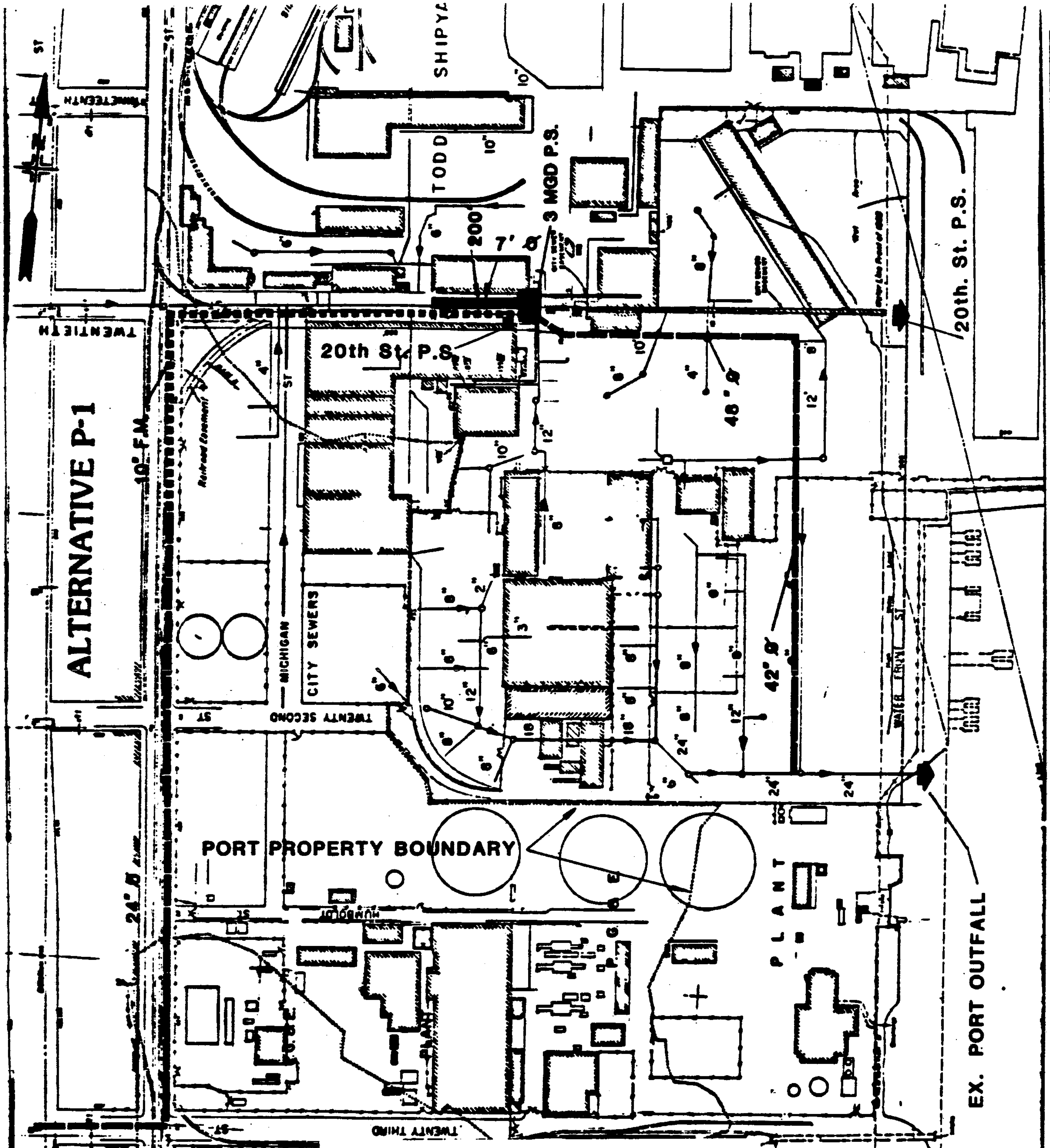



**FIGURE 3-9**

**ALTERNATIVE P-1**

ALTERNATIVE P-2

In Alternative P-2, flows from the southeastern portion of the Twentieth Street subbasin would be stored and transported northward via a proposed 66-inch gravity sewer from about Twenty-Second Street to a new 3 MGD package pump station. This pump station would be located in Port of San Francisco property in the vicinity of the intersection of Twentieth Street and Delaware Street extended. Flow would be transported westward on Twentieth Street and southward on Illinois Street via a new 10-inch force main and a new 24-inch gravity sewer as in Alternative P-1. See Fig. 3-10.

ALTERNATIVE G-1

This alternative would transport flow from three sub-areas of the Twentieth Street subbasin by gravity sewers to the Mariposa system. Wet-weather flow from the southeastern sub-area would be transported northward in a 42-inch diameter gravity sewer to the intersection of Twentieth Street and Delaware Street extended. From here, this flow would combine with flows from the northeastern sub-area and proceed westward in a 48-inch diameter gravity sewer to a point just west of the existing Twentieth Street Pump Station. The flow would continue along with flows from the remaining sub-area, in a 54-inch diameter gravity sewer to the intersection of Nineteenth Street and Illinois Street. Finally, the combined flows would drain northward on Illinois Street and empty into the proposed Mariposa Transport/Storage Box, where they would ultimately be pumped by the

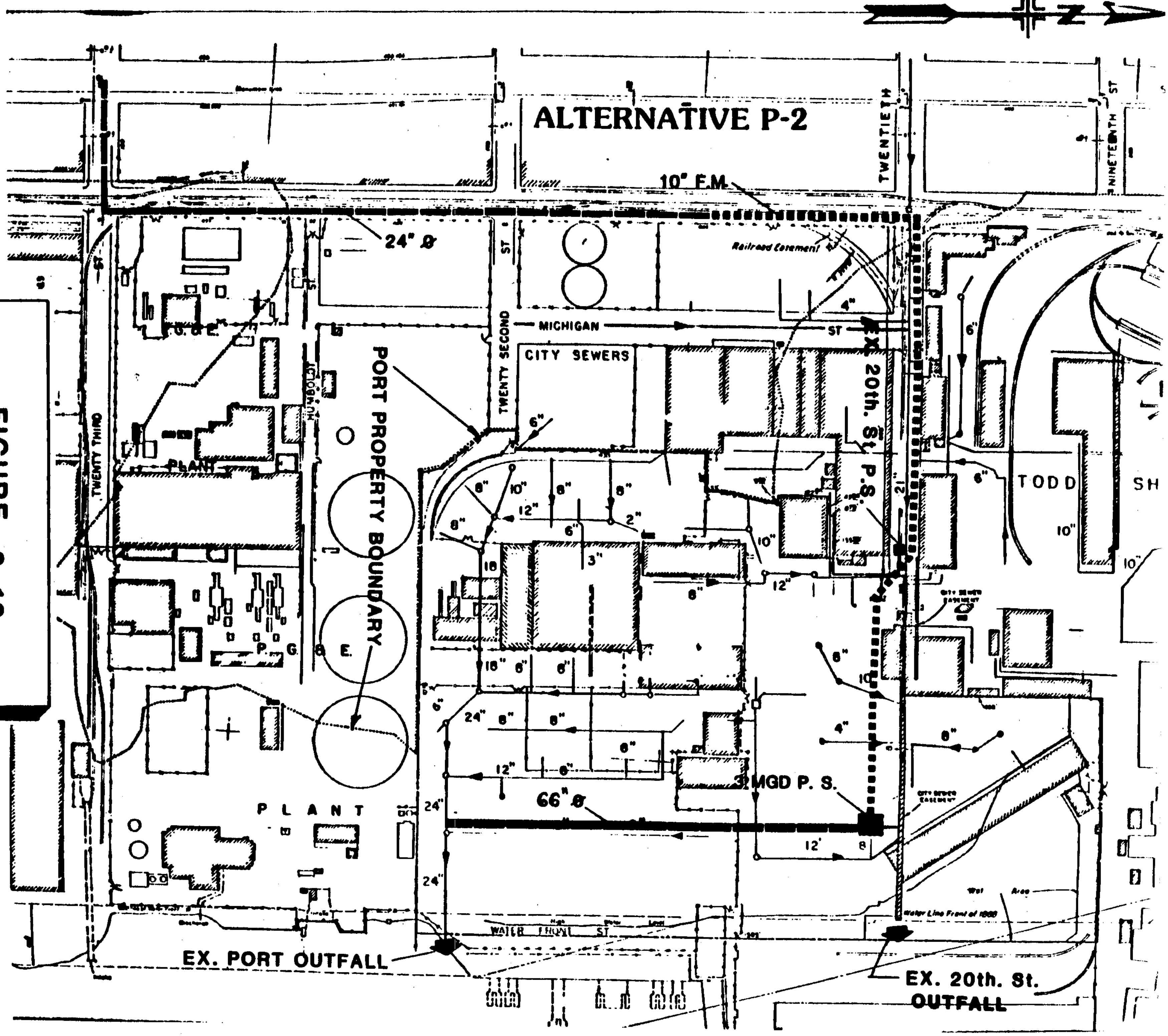



FIGURE 3-10
ALTERNATIVE P-2

Mariposa wet weather pump station to the SEWPCP for treatment and disposal. See Fig. 3-11.

In considering Alternatives P-1, P-2 and G-1, only the two pumping alternatives were selected for further analysis. The gravity solution was not retained because: (1) it would be significantly more expensive to construct, it would require a greater amount of construction along Illinois Street, and (3) the alignment would have to meander its way through a warehouse area in Port property. An alignment directly westward on Twentieth Street to Illinois Street would be deep, difficult and costly. The elevation along Twentieth Street westward from the existing pump station to Illinois Street increases from approximately elevation 0 to elevation 20 feet.

See Table 3-2 below.

TABLE 3-2 - TWENTIETH STREET ALTERNATIVES

CAPITOL COSTS (MILLION DOLLARS) ENR 5517

| ALTERNATIVE | CAPITOL COST |
|---|---|
| P-1 | 1.52 |
| P-2 | 1.28 |
| G-1 | 2.46 |

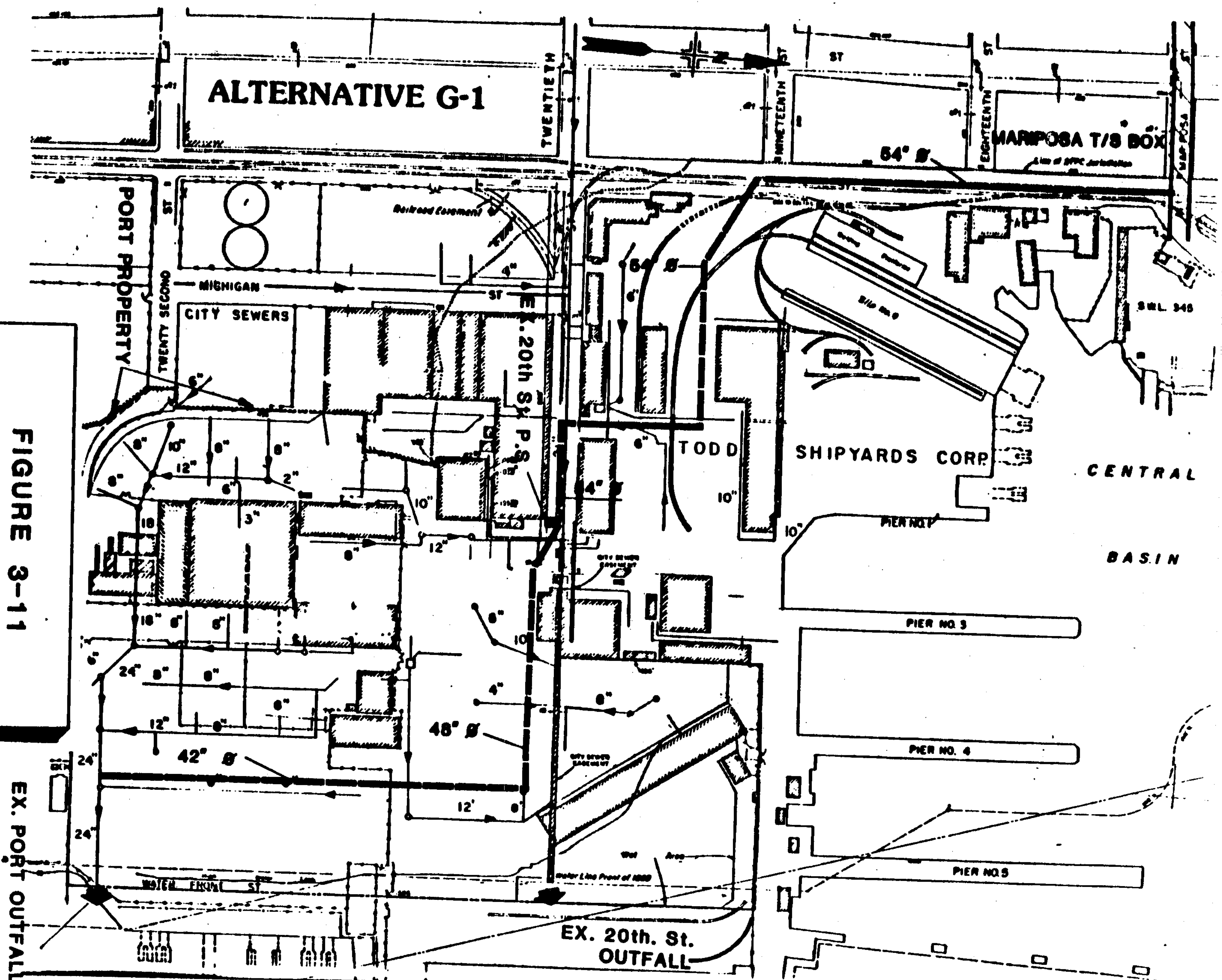



FIGURE 3-11
ALTERNATIVE G-1

# CHAPTER 4

## ANALYSIS OF ALTERNATIVES

The Mariposa Transport Storage Project is one component of the San Francisco Wastewater Master Plan. In this project, dry-and wet-weather flows from the Mariposa drainage basin are to be transported to the Islais Creek basin for treatment at the Southeast Water Pollution Control Plant.

### EXISTING MARIPOSA BASIN FACILITIES

The Mariposa drainage basin is comprised of the area immediately surrounding Central basin and is located about halfway between China basin and Islais Creek Channel on the shore of San Francisco Bay. The total area of the Mariposa basin is 271 acres and is composed of two subbasins: (1) a 220.3 acre tributary to the Mariposa Pump Station and a (2) a 50.7 acre tributary to the Twentieth Street Pump Station. Dry weather as well as stormwater flow is pumped by these two pump stations southward to the Islais Creek sewer system where the flow is mixed with flow from the Islais Creek basin and conveyed by gravity to the Southeast WPCP for treatment. The existing Mariposa transport system does not have the capacity to convey all wet weather flows out of the basin, resulting in a bayside average of approximately 46 combined sewer overflows each year to the bay. The current overflow volume is estimated to be 71 million gallons per year. New facilities are required to comply with NPDES permit limitation of ten overflows per year. The overflow volume after these facilities are constructed will be 13 million gallons per year.

The drainage boundary and locations of the existing Mariposa and Twentieth Street pump stations and force mains are shown on Fig. 4-1.

Mariposa Pump Station

The existing Mariposa Pump Station is designed to pump dry-weather as well as minor stormwater flows through a 10-inch diameter force main to a gravity sewer located at Third and Twenty-Second Streets; from there the flows are conveyed by gravity to the Southeast WPCP. The station's two pumps have a nominal capacity of 1 mgd each and are provided with two-speed drives. The station has space to add a third pump. The number of operating pumps and their speeds change to meet the diurnal dry-weather flow pattern. With a maximum water level in the wet well and with one pump operating at full speed, the station can pump 1.9 mgd. With the same wet well condition and both pumps operating at full speed, the station can pump only slightly in excess of 2.1 mgd. When the incoming stormwater level in the diversion structure rises above the overflow point, the hydrostatic pressure opens the flap gate to allow excess stormwater to overflow through a 6-foot diameter outfall to the bay.

Twentieth Street Pump Station

Two pumps with a rated capacity of 0.39 mgd each are installed at the Twentieth Street Pump Station. The station is designed to pump dry-weather as well as minor stormwater flows through a 6-inch diameter force main to a gravity sewer located at Illinois and Twenty-Second Streets. From there, the flows are conveyed by gravity to the

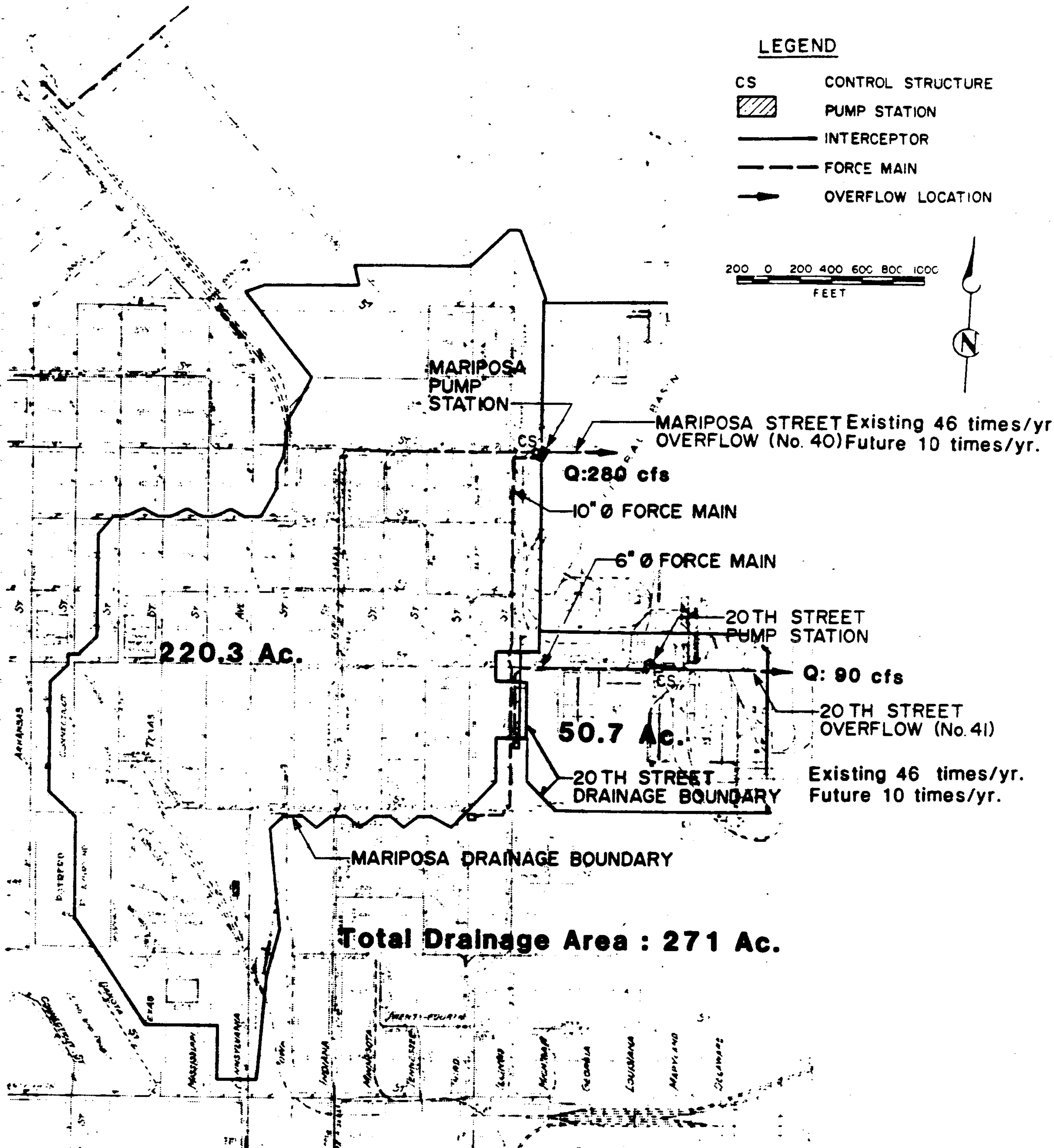



**Figure 4-1 Mariposa Drainage Basin**

Southeast WPCP. In wet weather, excess stormwater overflows a weir in the diversion structure to a 2-foot diameter outfall.

REQUIRED FACILITIES

Facilities are to be constructed to reduce the number of overflows from the Mariposa basin from approximately 46 per year to an average of 10 per year. Decreasing the overflows requires a sizeable increase in the yearly wet-weather flow volume which is conveyed to the City's treatment facilities. This increase can be accomplished through the use of a wet-weather storage facility and/or an increase in wastewater transport capacity from the Mariposa basin.

In a trade-off analysis, (see Appendix A) the best combination of wet weather storage volume and transport rate was determined for both the Mariposa and Twentieth Street drainage areas. Alternatives for the Mariposa subbasin facilities have been developed based on a 6 mgd transport rate and 1.3 million gallons of storage,and those for the Twentieth Street subbasin have been developed based on a 3 mgd transport rate and 175,000 gallons of storage.

MARIPOSA BASIN ALTERNATIVE

Several final alternatives for the Mariposa drainage area were evaluated in the 1982 Bayshore Facilities Plan, North Bayside Project Report, which was prepared for the San Francisco Clean Water Program after detailed analysis of the alternatives. An Apparent Best Alternative (ABA) was recommended and included a 1.5 million gallon wet-weather storage reservoir, a new five MGD wet-weather pump station and use of the existing Mariposa Pump Station and force main for dry-weather flow. This ABA was modified, as mentioned earlier, to include a 1.3 MG wet-weather storage and a six MGD pump station and is referred to as Alternative 1 (Modified) in this report amendment.

<u>Alternative 1: Pump Station/Reservoir (1982 ABA)</u>

This alternative was selected in the 1982 planning work as the Apparent Best Alternative to provide increased conveyance and storage of wet-weather flows prior to treatment at the SEWPCP. Due to re-analysis of the drainage area, however, facility sizes of this 1982 ABA have changed slightly. (See Chapter 3 for facility sizing)

Alternative 1 consists of a new 6 MGD wet-weather Mariposa Pump Station, a 1.3 MG offline covered reservoir at the site of the new station, and a new 16-inch diameter force main. This alternative would refurbish the existing Mariposa Pump Station by replacing the two existing pumps with two 1.35 mgd variable speed pumps (one will be for stand-by) and new electrical controls. This existing pump station and 10-inch force main would continue to handle the dry-weather operation.

The proposed 6 MGD pump station and 1.3 MG covered reservoir would be constructed on a privately owned lot located at the southside of Mariposa St., between Third and Illinois Streets. The size of the lot is approximately 0.45 acres. The required wet-weather pumping capacity of 6 MGD would be provided by two wet-weather pumps operating in parallel. The pump station, flushing facility, and odor control facilities would be housed in a structure, 24 feet by 100 feet, located on the west side of the site. The 1.3 MG covered and below grade reservoir would consist of four 88 foot by 25 foot basins. The effective storage depth of the reservoir is 24 feet.

Although the pump station and covered reservoir facility would be designed to provide the maximum transport of solid materials during a storm event, some solid and floatable materials are expected to accumulate in the storage facility. These materials have the potential for creating odors and corrosion problems if left in the reservoir for extended periods. Several control measures are built into the facility. After storm events, a high pressure water spray system would be used to clean the facility by resuspending the solids, grit and scum accumulated on the walls and floor of the reservoir and flushing them via the dewatering pumps to the existing sewer system. It is anticipated that an average of two flushing cycles per month over the 7 month wet-weather period would be required. Each flushing would require about 60,000 gallons of water.

Subsequent to operation of the Mariposa Transport/Storage facility, air may be vented from the reservoir and pump station to the atmosphere. Expelled air will be passed through an activated carbon system to remove any possible odors.

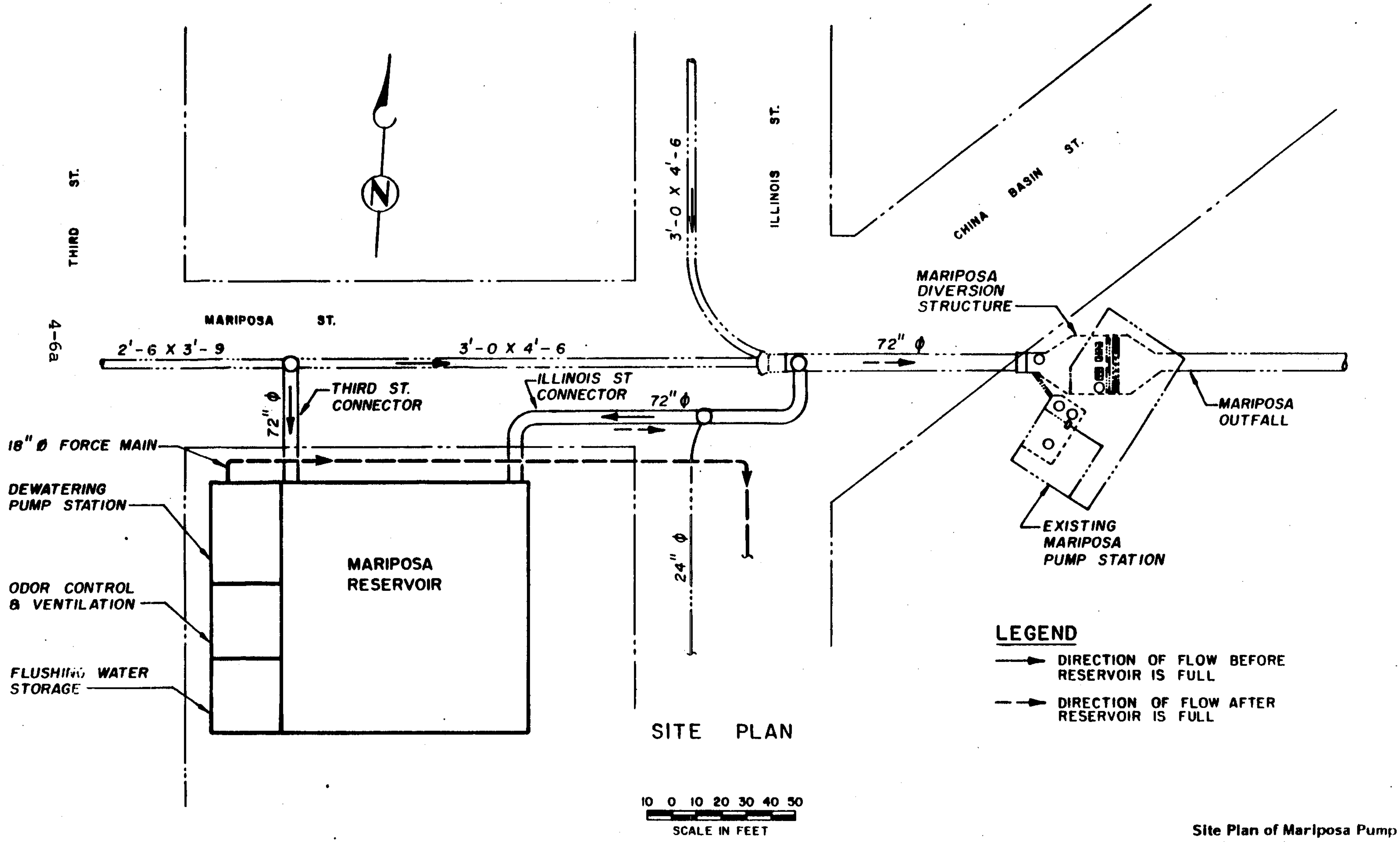
A 1,650 foot long, 16-inch diameter force main and a 1,750 foot long, 24-inch gravity sewer will be constructed to connect the proposed wet-weather pump station to the existing 3 foot by 4.5 foot Third Street sewer at Twenty-Third and Third Streets.

The route of the force main will begin at the wet-weather pump station, cross under the railroad tracks to the eastside of Illinois Street and proceed southerly along Illinois Street to Twenty-First Street extended. At Twenty-First Street, the force main will be intercepted by a new gravity sewer which will extend southward on Illinois Street to Twenty-Third and turn westward on Twenty-Third to Third. This 24-inch diameter gravity sewer will also intercept flows from the existing 10-inch Mariposa force main, which will be used for dry-weather flow and a new 10-inch force main from the Twentieth Street subbasin. See Figures 4-2, 4-3.

Alternative 2: Transport/Storage Box Sewer/Pump Station

Alternative 2 is similar to Alternative 1 except that the storage reservoir which was located on private property in Alternative 1 would be a storage box situated in Mariposa Street, between Third Street and the existing pump station. A new 6 MGD wet-weather pump station will be located inside the box. The existing Mariposa Pump Station, modified and updated, and the existing 10-inch force main would continue to be used for dry-weather flow.

An in-line Transport/Storage Box with dimensions 360 feet long, 22 feet wide, and 22 feet deep would be constructed on Mariposa Street between Third Street and the existing Mariposa Pump Station. The dry-weather flow would be prevented from entering the box sewer; and therefore, the box sewer structure would collect wet-weather flows only. A new pumping station would be constructed inside the box and




Site Plan of Mariposa Pump Station and Reservoir

**FIGURE 4-2**

CALDWELL·GONZALEZ·KENNEDY TUDOR
A JOINT VENTURE

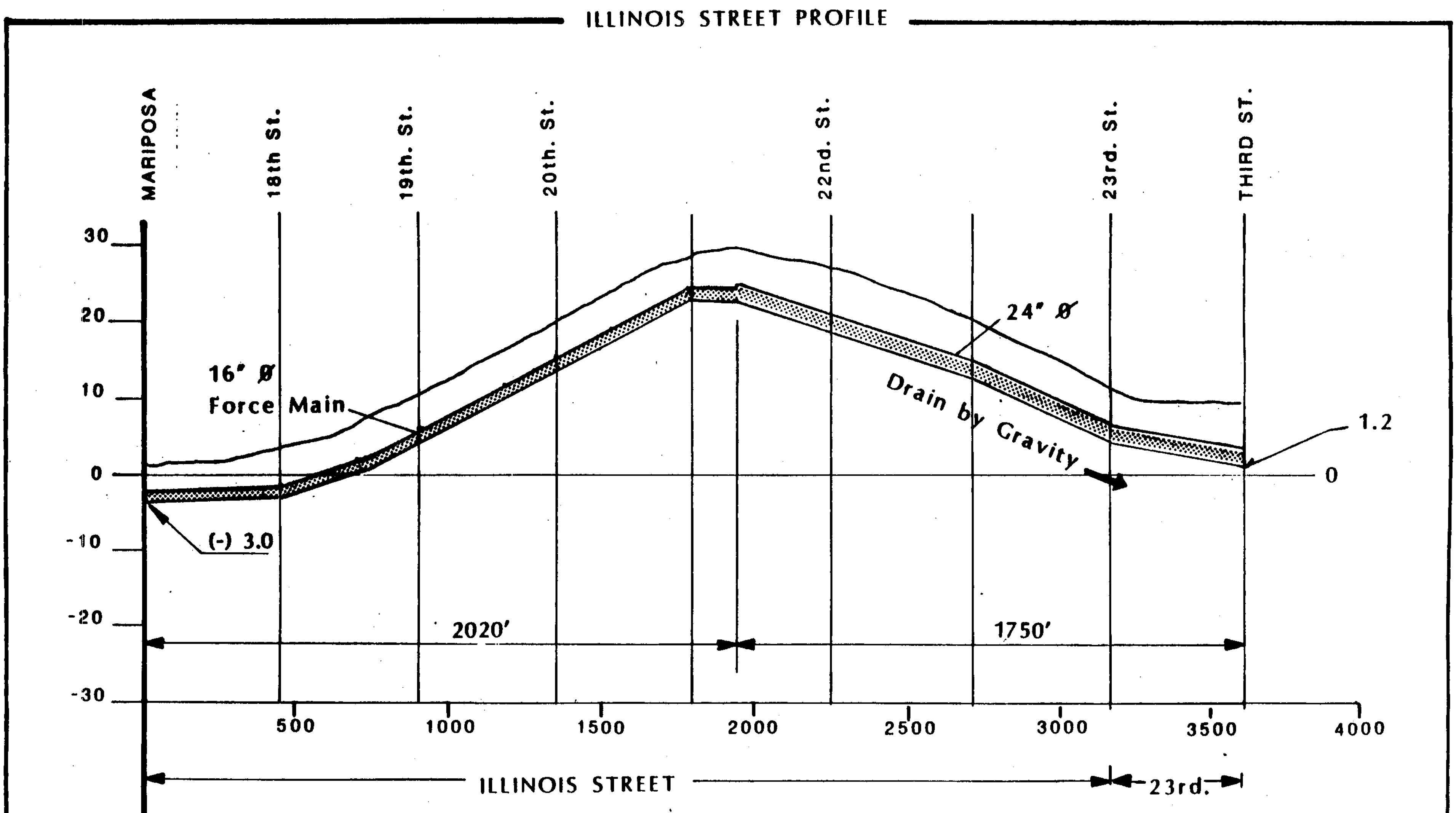

ILLINOIS STREET PROFILE
MARIPOSA
18th St.
19th. St.
20th. St.
22nd. St.
23rd. St.
THIRD ST.
30
20
10
0
-10
-20
-30
16" Ø
Force Main
24" Ø
Drain by Gravity
1.2
0
(-) 3.0
2020'
1750'
500
1000
1500
2000
2500
3000
3500
4000
ILLINOIS STREET
23rd.

FIGURE 4-3

would contain two wet-weather pumps and two small dewatering pumps. The pumping capacity of both wet-weather pumps operating in parallel would be 6.2 mgd. In addition, two new variable speed pumps of 1.35 mgd capacity each (one for stand-by), and new electrical controls would replace outdated equipment in the existing Mariposa Pump Station to handle dry weather flows. Wet-weather flow would be pumped through a new 16-inch force main on Illinois Street and would be intercepted by a new 24-inch gravity sewer along Illinois Street at Twenty-First Street extended. The 24-inch sewer would convey the flow from approximately Twenty-First Street to an existing 3 foot by 4.5 foot sewer connection at Twenty-Third and Third Streets (see Alternative 1). Dry-weather flow would be pumped through the existing 10-inch Mariposa force main on Illinois Street to the proposed 24-inch sewer at Twenty-First Street extended.

As in Alternative 1, some solid and floatable materials are expected to accumulate in the storage facility after a storm event. A water supply line with three hose connection points will be attached to the ceiling of the transport/storage facility so that the box can be washed down manually.

See Figures 4-4, 4-5.

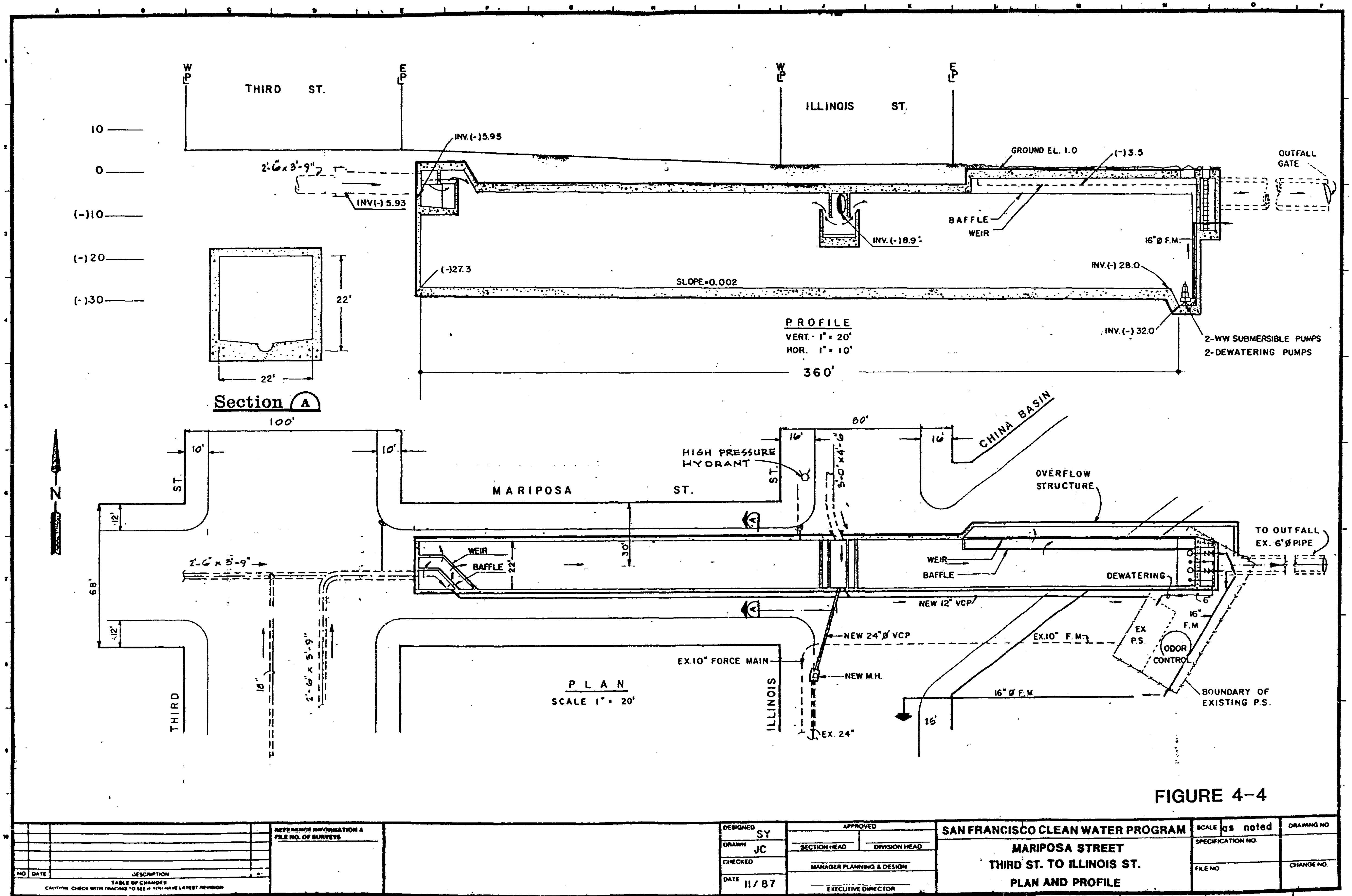
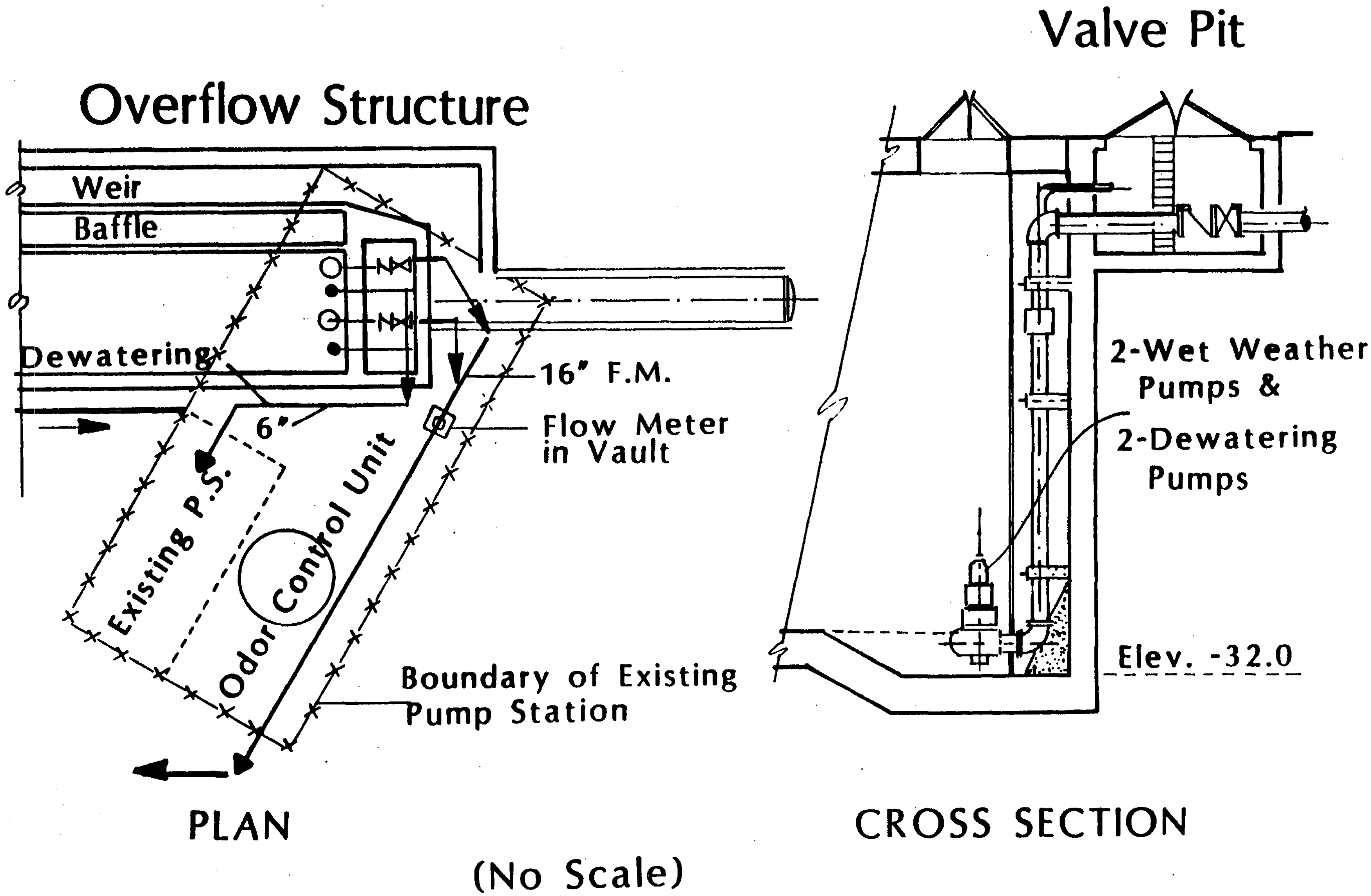

THIRD ST.
ILLINOIS ST.
INV.(-)5.95
2'-6" x 3'-9"
INV(-) 5.93
GROUND EL. 1.0
(-)3.5
OUTFALL GATE
BAFFLE
WEIR
INV. (-)8.9±
16" Ø F.M.
INV.(-) 28.0
(-)27.3
SLOPE=0.002
PROFILE
VERT. 1" = 20'
HOR. 1" = 10'
INV. (-) 32.0
2-WW SUBMERSIBLE PUMPS
2-DEWATERING PUMPS
360'
10
0
(-)10
(-)20
(-)30
22'
22'
Section A
100'
80'
10'
10'
16'
16'
CHINA BASIN
HIGH PRESSURE HYDRANT
3'-0" x 4'-6"
MARIPOSA ST.
OVERFLOW STRUCTURE
12'
68'
12'
30'
2'-6" x 3'-9"
WEIR
BAFFLE
22'
WEIR
BAFFLE
TO OUTFALL EX. 6' Ø PIPE
DEWATERING
6'
NEW 12" VCP
16" F.M.
NEW 24" Ø VCP
EX.10" F.M.
EX P.S.
ODOR CONTROL
EX.10" FORCE MAIN
NEW M.H.
BOUNDARY OF EXISTING P.S.
16" Ø F.M.
15'
EX. 24"
18"
2'-6" x 3'-9"
THIRD
ILLINOIS
PLAN
SCALE 1" = 20'
N
TABLE OF CHANGES
NO DATE DESCRIPTION
REFERENCE INFORMATION & FILE NO. OF SURVEYS
DESIGNED SY
DRAWN JC
CHECKED
DATE 11/87
APPROVED
SECTION HEAD
DIVISION HEAD
MANAGER PLANNING & DESIGN
EXECUTIVE DIRECTOR
SAN FRANCISCO CLEAN WATER PROGRAM
MARIPOSA STREET
THIRD ST. TO ILLINOIS ST.
PLAN AND PROFILE
SCALE as noted
DRAWING NO
SPECIFICATION NO.
FILE NO
CHANGE NO.

FIGURE 4-4




MARIPOSA WET WEATHER PUMPING STATION

FIGURE 4-5

The evaluation of alternatives includes energy requirements, cost, environmental considerations, traffic and local access impacts during construction, construction spoil quantities; and additional considerations such as: use of scarce resources, flexibility, reliability, ability to implement, public acceptability and monetary cost.

A. <u>Energy Requirements</u>: Energy requirements for both of the Mariposa Transport/Storage alternatives are shown below:

| ALTERNATIVE | PEAK DEMAND, Kw | ENERGY USED MILLION KWHR/YR[a] | RESIDENTIAL EQUIVALENT [b] |
|---|---|---|---|
| 1 & 2 | 115 | 0.144 | 22 |

[a]Includes dry weather flow pumping and auxiliary energy.

[b]Residential equivalent is the number of Bay Area residences which would consume the same energy as the alternative based on PG&E data showing single family residential energy use to average 6,600 KWHR/YR without air conditioning.

B. Monetary Costs:

Alternative 1 has a present worth cost of $8.8 million. while Alternative 2 has a present worth of $6.8 million. Therefore Alternative 2 is favored by a cost savings of $2 million or nearly 25% over Alternative 1. See Table 4-1.

C. Traffic and Access - Alt. 1 and Alt. 2

The proposed Mariposa transport/storage facilities are located in a heavily industrialized area of the City known as the Central Basin. Land uses in this area include a mix of heavy and light industrial, boat marina operations, and multi-family housing. The heavier industrial activities include materials warehousing and ship-repair.

Through-traffic routes in the Mairposa project area are sparse because of the barriers created by navigable creeks, the San Francisco Bay to the east, and State Route (SR) 101 and hilly topography to the west. Although there is access to and from I-280 in this area, the only north-south surface arterial is Third Street, a divided four-lane street with parking along both curbs. East-west through traffic is confined to Army Street and 16th Street, both of which are four-lane two-way streets with parking at the curbs.

Local streets that may be affected by the proposed project include Mariposa Street from Third to Illinois, 23rd Street between Third and Illinois, and Illinois Street from Mariposa to 23rd. Illinois Street has a double railroad track (Santa Fe) along its center.

Table 4-1 Estimated Costs

Mariposa Transport/Storage Facility - ENR 5517

| Items | Cost, million dollars | |
|---|---|---|
| | Alternative 1 | Alternative 2 |
| Structural elements, reservoir or transport storage structure | 4.01 | 2.96 |
| WW pumps | 0.46 | 0.46 |
| DW pumps | 0.18 | 0.18 |
| Flushing | 0.15 | 0.01 |
| Odor control | 0.06 | 0.08 |
| Force main & gravity sewer | 1.10 | 1.16 |
| Construction cost | 5.96 | 4.85 |
| Contingencies (10%) plus Professional services (16%) | 1.55 | 1.26 |
| Land (reservoir site) | 0.61 | --- |
| Total Capital Cost | 8.12 | 6.11 |
| Annual O&M | 0.07 | 0.07 |
| Present Worth O&M | 0.66 | 0.66 |
| Total Present Worth | 8.78 | 6.77 |
| Equivalent Annual Total Cost | 0.94 | 0.72 |

The peak hours of the through routes tend to be 7:30 to 8:30 AM and 4:30 to 5:30 P.M. Because the predominant flows are north and south, volumes on Third Street are larger than on either Army Street or 16th Street. Traffic on local streets is generally light, even during peak hours, because most of the adjacent land uses generate relatively little traffic. Mariposa Street west of Third, however, has heavier traffic flows especially during the PM peak because it accesses I-280.

Three MUNI transit routes traverse the project area. These include the motor coach 15 Third Street and 48 Quintara and trolley coach 22 Fillmore. Since Line 22 draws its power from overhead electrical wires, it is most vulnerable to disruption because of construction within the area.

Haul Routing:

Construction spoils will be hauled from the project site to the local freeways by the most convenient surface street routes. The most convenient southbound freeway access is to I-280 southbound at either Pennsylvania and 26th Street or further north from Mariposa Street. Since these entrances are north of the I-280/SR-101 junction, these ramps also provide direct access to SR-101. The most convenient of these two ramps will depend on the time of day and the north/south orientation of trucks during loading. The freeway access points to the north and east are the SR-101 Army/Bayshore northbound ramp, I-280 Fifth/Bryant eastbound ramp, I-480

Second/Bryant eastbound ramp and the I-480 Essex/Harrison eastbound ramp. The most direct route, however, will be up Third Street to the northern ramps.

From the south, the most direct inbound routes from the freeways are at the I-280 northbound ramps at Army Street and Mariposa Street. Because of existing truck traffic and intersection geometry along the other routes, the I-280 Army Street northbound ramp would be the best alternative. From the north and east, I-80, the most direct route to the project area is via Eight, Townsend, Seventh, 16th and Third Streets.

Summary of Potential Traffic Impacts:

The following discussion of potential traffic impacts applies to both the Pump Station/Reservoir alternative and the Transport/Storage Box alternative.

There is light weekday traffic on both Illinois Street and Mariposa Street. The intersection of these two streets will be affected by the construction of either alternative. Alternative No. 2 would have a greater affect on traffic due to the construction in the street. This intersection could be closed or traffic required to share use of only one lane on each street provided flagmen were available for traffic control during peak hours. Closure of the intersection is not feasible because it would require a circuitous detour to reach China Basin Street. The Santa Fe has railroad tracks which are required for industry service down Illinois Street which may require bridging. Construction within this area may cause disruption of access to rail lines and the Santa Fe railyard.

The Third/23rd Streets intersection would be affected by construction of the proposed 24-inch sewer, especially during heavy peak period traffic along Third Street. The intersection is traversed by the 48 Quintara bus and north/south by the 15 Third Street bus which is heavily utilized and has very frequent peak and off peak service. Although alternative routes exist, the intersection cannot be closed to north/south through traffic without severe congestion. Turning movements from 23rd Street could be temporarily eliminated as long as access from 22nd Street to the MUNI facility was provided.

In addition, construction of the T/S Box, alternative No. 2, would significantly impact the access of two adjacent businesses. There is a concrete batch plant located on the northwest corner of Mariposa Street and Illinois Street. Trucks enter the site on Illinois St. and exit full on Mariposa St. There may be sufficient on site space to allow trucks to double back inside the facility and exit on Illinois Street so as to not impact construction of the storage facilities. If this is not possible, staging of construction of the storage facility may be required to accommodate trucks exiting the plant via new exit gates along Mariposa Street near 3rd Street. Also, there is a bus yard with entrance/exit on the southside of Mariposa Street between 3rd and Illinois Streets. Alternate access for buses need be provided from Illinois Street during construction.

<u>Proposed Mitigation Measures</u>:

Proposed mitigation measures for both alternatives are:

1. Avoid closure of the Mariposa/Illinois Streets intersection during peak periods. Provide adequate detour signing other times. If limitation to one lane is required during peak periods, provide flagmen for traffic control. Mariposa Street between Illinois and Third may be closed if access is provided to adjacent businesses and through traffic detoured on 19th or 20th Street.
2. Coordinate with the Santa Fe railroad to determine how best to provide access for railroad service.
3. Avoid closure of 23rd/Third Streets intersection. Keep two through lanes open in each direction on Third Street during peak periods and keep one through traffic lane open during off peak periods.
4. Restrict parking on Illinois as necessary to maintain adequate traveled way width (20 feet) during installation of the 16-inch force main and the 24-inch sewer.

   Traffic information provided in this section was obtained from, Final Report, Mariposa Facilities Traffic Study, DeLeuw, Cather and Company, February 1988.
5. Coordinate construction with concrete batch plant and bus yard operations.
6. Provide alternate access from Illinois Street for the bus yard.

C. Construction Spoils

Spoils are the excess excavated materials during the construction of the facilities which cannot be replaced as backfill and must be hauled off by truck for disposal at a specified site. Construction spoils for Alternatives 1 and 2 are:

EXCAVATED VOLUME

| ALTERNATIVE | EXCAVATED VOL. (C.Y.) | +20% SWELL (C.Y.) |
|---|---|---|
| 1 | 22,188 | 26,626 |
| 2 | 19,022 | 22,826 |

In order to avoid spilling dirt, trucks will not be overloaded. Speed limits will be enforced. Truck wheels will be hosed off as necessary due to muddy conditions before leaving the construction sites.

D. Environmental Considerations

A preliminary assessment of the more important impacts of the Mariposa Transport/Storage Facility alternatives is presented in the following paragraphs:

1. The only long term impact of either of the two alternatives would be a commitment of energy to pumping.
2. Short term impacts of the two alternatives is presented below. The construction of the storage reservoir in Alternative 1 would involve noise from pile driving. Also, it would cause some traffic disruption due to construction vehicle movements to and from the site.

Construction of the storage box under Mariposa Street Alternative 2, would cause disruption of traffic and restrict access to adjacent businesses along Mariposa Street from Third Street to the site of the existing pump station. There will also be noise from pile driving.

The wet-weather force main and gravity sewer alignment along Illinois Street to Third and Twenty-Third Streets is the same for both alternatives and thus would have the same short term impacts in: dust, noise, traffic and access disruption.

There would be more disruption in Mariposa Street relative to Alternative 2 than in Alternative 1 because construction of storage is in Mariposa Street rather than off street on private property.

There might be some additional temporary traffic disruption and temporary interference with access to the boat works facility on Port Authority property.

E. Additional Considerations

The additional considerations are use of scare resources, flexibility, reliability, ability to implement, compatibility with local planning goals and objectives, bypass hazard, flood protection, land use conflicts, and public acceptability. A summary of these considerations is presented in Table 4-2 and key points are presented as follows:

1. Scarce resource consumption for both alternatives is limited to land and operating energy. The new land requirement of Alternative 1 is less than 0.5 acres and can be satisfied by acquisition of a 0.45 acre lot which is presently undeveloped. There is no new land requirement for Alternative 2 because the storage and pumping facilities would be located under a City street. Energy consumption in pump station operations is 144,000 KWHR/YR, the equivalent consumption of 22 Bay Area single family residences.
2. Both of the alternatives have flexibility to meet future reduction in the number of allowable overflows through increase in pumping (by installing large pumps) and/or the addition of storage capacity. If Alternative 1 is implemented, expansion of the approximate 0.23 acre reservoir on the 0.45 acre lot would probably not be practical. However, addition of supplemental storage under Mariposa, China Basin, or Illinois Streets would be possible subject to Port Authority approval. If Alternative 2 is implemented, future expansion of the storage structure or additional storage under China Basin Street would be possible if approved by the Port Authority.
3. Alternatives 1 and 2 are equally reliable. The ability to store dry-weather flow in the event of pump station outage and the ability to pump dry-weather flow with the new wet-weather pump station increases the reliability of dry-weather flow management under both alternatives.

4. Implementation of the alternatives would either require the purchase of 0.45 acres of privately owned land for the wet-weather pump station and reservoir (Alternative 1) or an agreement with the Port Authority for a permit to construct and maintain a storage facility under a section of Mariposa Street. (Alternative 2)

   The implementation of both alternatives, which transport Mariposa wet-weather flow to the existing Third Street sewer at Twenty-Third and Third Streets, is dependent on adequate wet-weather capacity in the existing 3.0 feet by 4.5 feet Third Street sewer to accommodate the dry-and wet-weather flow from Mariposa. The Third Street sewers may need to be enlarged in the future because they are inadequate for even the existing flow rates.

5. All facilities of both alternatives could be completed within a 12 month construction period. Dry-weather flow patterns can be maintained during construction of either alternative by supporting the sewers in place or by pumping.

   During construction, there would be temporary traffic and visual disruptions resulting from open-cut construction at the sites of the transport/storage or reservoir facilities, pump stations, and pipelines.

   Long term visual effects are expected to be minimal under Alternative 1. Under Alternative 2, there would be no additional buildings constructed because the wet-weather pump station will be constructed within the transport/storage box.

The facilities included in the final alternatives are expected to operate very quietly for the duration of their service life. During construction, it is expected that noise and vibration would be generated by vehicles, pile drivers, excavation equipment, compressors, etc. It is anticipated that construction activities would be limited to no more than 10 hours per day.

Design criteria for all alternatives require that there be no odors emitted during operation of the facilities. During construction, localized odors may be emitted where there is excavation in bay mud. Dust would be created by construction equipment and exhaust fumes would be emitted from the equipment.

F. Construction Employment

The amounts of direct construction labor and secondary employment that would be generated by implementing the Mariposa alternatives have been estimated and are presented below. Secondary employment is that required to support the construction such as providing the basic materials (cement, pipe, etc.) or manufacturing pumps and other equipment items.

| Alternative | Direct Construction Employment, Worker Years | Secondary Employment Worker Years |
|---|---|---|
| 1 | 40 | 107 |
| 2 | 30 | 81 |

Table 4-2 Summary of Additional Considerations for Mariposa Transport/Storage Final Alternatives

| | Description | Alternative 1 | Alternative 2 |
|---|---|---|---|
| 1. | Scarce Resources | Requires 0.45 acres of private land. Pumping (DW & WW) energy of 144,000 kwhr/yr. | City street provides majority of space requirement. Small additional space required within Port property. Pump energy same as Alt. 1. |
| 2. | Flexibility | Adjustment to a future reduction in the number of allowable overflows could be made through a combination of increased transport capacity (install larger pumps) and increased storage (add storage in Mariposa Street to supplement the reservoir). The 0.45 acre size of the reservoir site would make expansion of the initial 1.3 mg reservoir on this private property parcel impractical. | Adjustment to a future reduction in the number of allowable overflows could be made through a combination of increased transport capacity (install larger pumps) and increased storage in Mariposa and/or China Basin Street. |

Table 4-2 Summary of Additional Considerations for Mariposa Transport/Storage Final Alternatives (continued)

| | Description | Alternative 1 | Alternative 2 |
|---|---|---|---|
| 3. | Reliability | Reliability would be dependent upon the performance of the new Mariposa wet-weather pump station. However, the storage facility would provide backup for both the wet-weather and the dry-weather pumping systems. In the event the dry-weather pump station was inoperable, incoming flow would overflow to the wet-weather pump station.<br><br>If both stations were inoperable, (for example, during a power failure), the wastewater would flow to the storage facility. That facility would have capacity to store 3 days of dry-weather flow. During wet weather, the time to fill the reservoir would depend on storm intensity. Dry-or wet-weather overflows from storage to the Bay would be subjected to partial removal of waste solids. For the above reasons, this alternative represents | Same as for Alternative 1. |

Table 4-2 Summary of Additional Considerations for Mariposa Transport/Storage Final Alternatives (continued)

| Description | Alternative 1 | Alternative 2 |
|---|---|---|
| | significant improvement in reliability over the existing dry-weather system and is considered to be adequately reliable for wet-weather flow management. | |
| | All proposed facilities and pipelines would be underground structures and no more vulnerable to natural disasters such as earthquakes than the present wastewater collection system. | Same as for Alternative 1 |
| 4. Implementation | Acquisition of 0.45 acre privately owned lot is required. Acquisition may be negotiated or by eminent domain. The property is undeveloped other than paved for parking, which lessens value; however, the bus-parking business may require relocation costs. There are no other known implementation problems. | Acquisition from Port Authority of a right to construct the storage facility within lands where the Port has jurisdiction had been previously obtained for other facilities. Negotiation of reimbursement of the Port Authority for lost revenues during construction may be necessary. |
| 5. Compatibility with local planning goals and objectives. | No known conflict. | No known conflict. |

Table 4-2 Summary of Additional Considerations for Mariposa Transport/Storage Final Alternatives (continued)

| | Description | Alternative 1 | Alternative 2 |
|---|---|---|---|
| 6. | Bypass hazard | Bypass hazard is minimal because flows are routed into storage and bypass cannot occur until storage is full. Bypass could occur thereafter with a premature overflow only if the wet-weather pumps fail. | Same as for Alternative 1. |
| 7. | Flood protection | There is no flood hazard to the project The project would not increase or decrease local flooding potential. A flap gate at the diversion structure prevents flooding of the sewer system and pump station during high tides. | There is no flood hazard to the project The project would not increase or decrease flooding potential. A weir structure will replace the existing flap gate as a tide excluding device. |
| 8. | Land use conflicts | No known conflict. | No known conflict. |
| 9. | Public acceptability | The public is committed to reducing water pollution and supports such construction. However, taking private land for public purposes is less acceptable if there is any other reasonable alternative. It is against the design criteria and would reduce the tax base. | The public is committed to reducing water pollution and supports such construction. This project is very similar to other projects which have received public support. |

## TWENTIETH STREET SUBBASIN ALTERNATIVES

### Alternative P-1

Under this option, the existing 20th St. Pump Station would be abandoned and a proposed 3 MGD package pump station would be located in a City street at the site of the existing 20th Street pump station. A transport/storage structure consisting of a 7-foot diameter, 200-foot long pipe would be placed in 20th Street, extending west from the pump station. A proposed 10-inch force main would transport combined sewage west from the new 3 MGD pump station up 20th Street and south on Illinois Street to join the proposed 24-inch gravity sewer described earlier as part of the Mariposa subbasin facilities.

To capture wet-weather flow originating from presently unsewered Port of San Francisco property, a 42-inch gravity sewer would be installed from about 22nd Street extending north through Port property to 20th Street. At 20th Street it would connect to a 48-inch gravity sewer, which would convey stormwater west to the new 3 MGD pump station at 20th Street and Louisiana Street extended. The Port may or may not construct this or a similar drainage system on its property in the future. The proposed pump station and transport/storage structure have sufficient capacity to handle dry- and wet-weather flow from the existing drainage area and the presently unsewered Port of San Francisco property. (See Figure 4-6 and Table 4-3.)

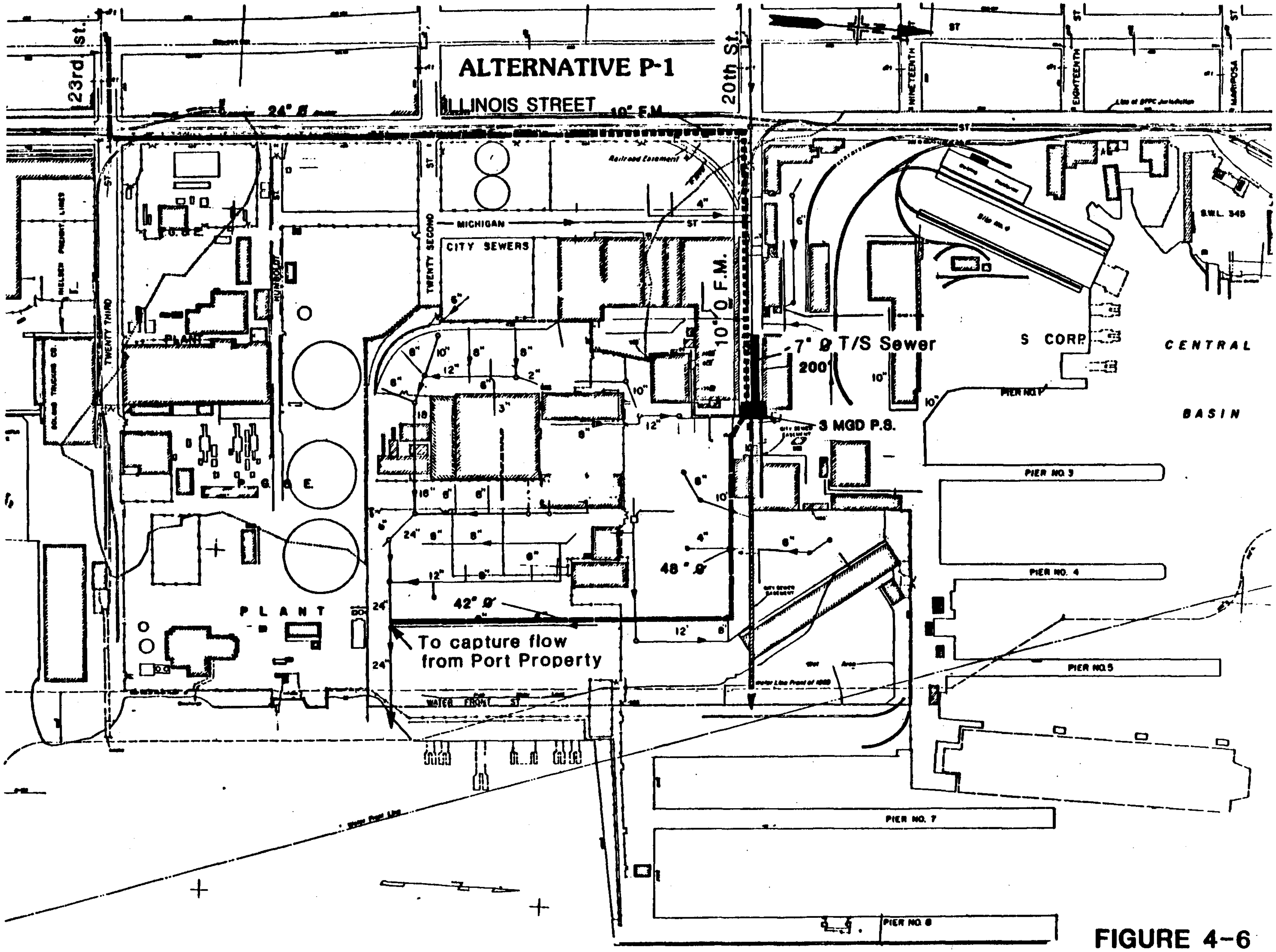

ALTERNATIVE P-1
23rd St.
20th St.
ILLINOIS STREET
24" Ø
10" F.M.
MICHIGAN ST
CITY SEWERS
TWENTY SECOND
TWENTY THIRD
10" F.M.
7' Ø T/S Sewer
200'
3 MGD P.S.
S CORP
CENTRAL
BASIN
PIER NO. 3
PIER NO. 4
PIER NO.5
PIER NO. 7
PIER NO. 8
P. G. & E.
PLANT
48" Ø
42" Ø
To capture flow
from Port Property
WATER FRONT ST
NINETEENTH
EIGHTEENTH
MARIPOSA

FIGURE 4-6

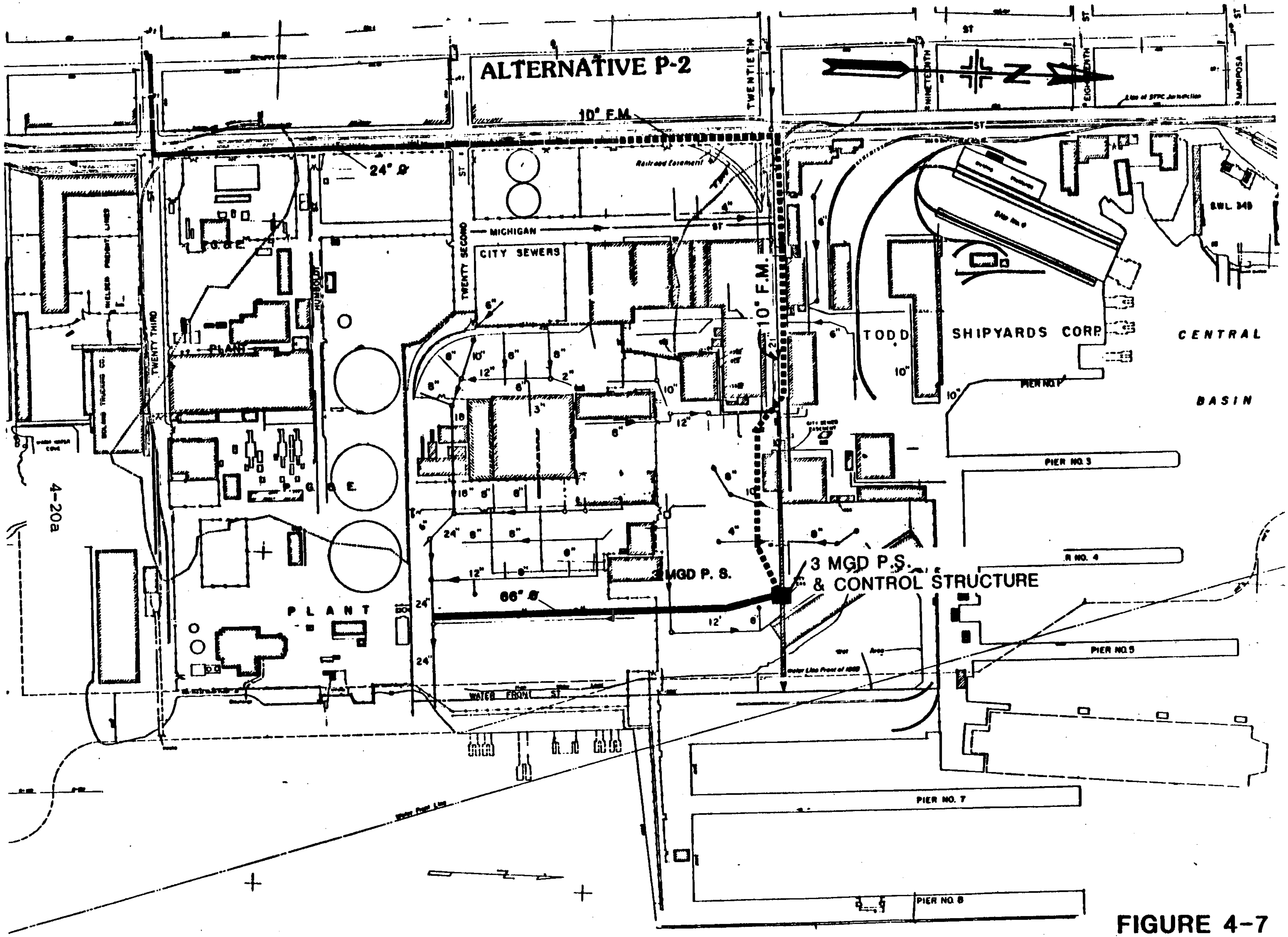
Table 4-3 Major Elements - Alt. P-1

| Element | Location | Dimension | Length |
| --- | --- | --- | --- |
| 42"Ø sewer | Southern portion of drainage area north to 20th/Delaware | 42-inch | 1060 ft. |
| 48"Ø sewer | 20th/Delaware west to 20th/ Louisiana | 48-inch | 660 ft. |
| 10"Ø force main | 20th/Louisiana west to 20th/ Illinois, south to Illinois/21st | 10-inch | 1182 ft. |
| 7'Ø sewer | 20th/Louisiana west to 20th/ Georgia | 7-foot | 200 ft. |
| 3 MGD Pump Station | 20th/Louisiana | | |
| Control Structure | 20th/Louisiana | | 25 ft. |

Alternative P-2

In alternative P-2, storm flows from the southeastern portion of the Twentieth Street drainage area would be stored/transported northward via a proposed 66-inch diameter, 1,060-foot long gravity sewer to a new 3 MGD package pump station. The existing 20th Street Pump Station would be abandoned. The pump station would be located in Port of San Francisco property at the extensions of 20th and Delaware Streets. Flow would be pumped westward on Twentieth Street and southward on Illinois Street via a new 10-inch force main and to the new 24-inch gravity sewer described as part of the Mariposa subbasin facilities.

See Figure 4-7 and Table 4-4.




4-20a

FIGURE 4-7

Table 4-4 Major Elements - Alt P-2

| Element | Location | Dimension | Length |
|---|---|---|---|
| 66"Ø sewer | Southeastern portion of drainage area to 20th/ Delaware | 66-inch | 1060 ft. |
| 10"Ø force main | 20th/Delaware west to 20th/ Illinois, south to Illinois/21st | 10-inch | 1372 ft. |
| 3 MGD Pump Station | 20th/Delaware | | |
| Control Structure | 20th/Delaware | | 25 ft. |

## EVALUATION OF ALTERNATIVES P-1 AND P-2

### A. Energy Requirements

Energy requirements for the two Twentieth Street Transport/Storage Facility alternatives are almost identical and are presented below.

| ALTERNATIVE | PEAK DEMAND, KW | ENERGY USED MILLION KW-HR/YR | RESIDENTIAL EQUIVALENT |
|---|---|---|---|
| P-1/P-2 | 48 | 0.0092 | 2 |

### B. Traffic and Access Alt P-1 and P-2

The 20th Street area is an industrial, shipyard, and warehouse area with no through traffic. The only local streets to be affected by construction within this area are 20th Street from Illinois to Louisiana Street extended and Illinois Street from 20th to 21st. The intersections of 20th and 22nd Streets with Illinois must be kept open to provide access to these dead end streets. Also, at the intersection of 20th and Louisiana Streets extended (location of existing pump station), enough clearance should be provided to allow truck access to and from yard sites. The construction of Alternative P-1 would have a greater impact at this intersection since it will be the location of the new pump station and the storage sewer.

Haul routing for the 20th Street alternatives would be the same as that discussed for the Mariposa alternatives.

Proposed mitigation measures:

1. Avoid closure of the Illinois/20th intersection. Provide flagmen for traffic control during peak periods if only one through lane can be maintained.
2. Avoid closure of 20th Street east of Illinois Street. Maintain access to businesses. Provide flagmen for traffic control if only one through lane can be maintained.

C. Construction Spoil

Construction spoil quantities for each alternative are shown below.

| ALTERNATIVE | EXCAVATED VOLUME (C.Y.) | EXCAVATED VOLUME +20% SWELL (C.Y.) |
|---|---|---|
| P-1 | 6,861 | 8,234 |
| P-2 | 5,593 | 6,711 |

D. Environmental Considerations

The only long-term impact of either of the two final alternatives would be a commitment of energy to pumping as shown below:

| ALTERNATIVE | PEAK DEMAND, KW | ENERGY USED MILLION KW-HR/YR | RESIDENTIAL EQUIVALENT |
|---|---|---|---|
| P-1/P-2 | 48 | 0.0092 | 2 |

Short term impacts of alternatives P-1 and P-2 would essentially be the same, consisting of dust, noise and minor traffic disruption.

In both alternatives, there would be some traffic disruption along 20th Street, and Illinois Street between 20th and 21st Streets due to construction of the 10-inch diameter force main. However, in Alternative P-1 there would be additional traffic complications due to construction of the new pump station and the 7-foot sewer at the intersection of 20th and Louisiana Streets extended. Although trailer truck traffic through this area could be maintained, it would be somewhat restricted.

Since the 20th Street drainage subbasin is a warehouse, shipyard area with many abandoned buildings, environmental considerations such as dust, noise, and construction vehicle traffic should not create any significant impacts.

E. Additional Considerations

1. Scarce Resources:

Scarce resource consumption for both alternatives is limited to land and operating energy.

In alternative P-1, all elements of the project to be constructed by the City of San Francisco (7-foot diameter sewer, 10-inch force main, pump station) will be built in City Streets; therefore, no new land requirements are necessary. Construction of the 42-inch and 48-inch diameter sewers will be the responsibility of the Port Authority.

In Alternative P-2, the pump station, 66-inch diameter sewer, and a portion of the 10-inch force main are to be constructed on Port property and therefore requiring negotiations between the City of San Francisco and the Port Authority.

2. Flexibility:

Both alternatives have flexibility to meet future reduction in the number of allowable overflows through increase in pumping and storage capacity.

Pumping capacity under both alternatives could be increased through an addition of a pump within the pump station if space has been provided or by replacement of the original pumps with new larger ones. In Alternative P-1, additional storage could be provided by lengthening the proposed 7-foot diameter sewer. For P-2, supplemental storage facilities could be constructed along the length of the proposed 66-inch diameter sewer.

3. Reliability:

For both alternatives, reliability would be dependent upon the performance of the new pump station. The storage capacity would provide back-up in the event the pump station became inoperable, storing several days of dry-weather flow, and a limited amount of wet-weather flow.

As in the Mariposa subbasin alternatives, all proposed facilities and pipelines would be underground structures and no more vulnerable to natural disasters than the present wastewater collection system.

4. Implementation:

Acquisition from the Port Authority, of a right to construct facilities within their property will be a factor in the implementation of either alternative, but will be of greater importance with Alternative P-2 because of its greater impact to Port property. The pump station and transport/storage sewer would be constructed on Port property with Alternative P-2.

In Alternative P-1, if a right to construct is not granted by the Port, the pump station, force main, and storage sewer could still be built because construction would occur within City streets. For Alternative P-2, if construction rights are not granted, this project could not be implemented at all.

5. Compatibility with local planning goals and objectives:

No known conflict with local planning goals and objectives would occur with the implementation of either alternative.

6. By-pass hazard:

No planned dry-weather by-pass will be designed into either alternative project. If the pump station fails, dry-weather flow could be stored for several days while the pump station was being restored to use. When storage capacity has been reached; however, an overflow could occur.

7. Flood Protection:

There is no flood hazard to the project, and therefore no special flood control measures are needed.

8. Land Use Conflicts:

The only known potential land conflict would occur if the Port has plans for the area required for the pump station and storage facility. An agreement with the Port Authority regarding construction within its property will be needed.

9. Public Acceptability:

It is anticipated that both P-1 and P-2 will be acceptable to the public because all of the construction, with the exception of a portion of the 10-inch force main on Illinois Street between 20th and 21st Streets, will occur within a industrial/warehouse area of 20th Street.

F. Construction Employment

Estimated construction employment for the 20th Street area is shown below.

| Alternative | Direct Construction Employment, Worker Years | Secondary Employment Worker Years |
|---|---|---|
| P-1 | 15 | 42 |
| P-2 | 13 | 36 |

G. Cost Estimates:

Cost estimates for 20th Street Alternatives P-1 and P-2 are presented below:

Table 4-5. Cost Estimate/Alternative P-1 & P-2

(ENR = 5517, January 1987)

Alternative P-1

| Cost Item | City Cost (Million $) | Port Cost (Million $) | Total Cost (Million $) |
|---|---|---|---|
| Force Mains & Gravity Sewers | .37 | .76 | 1.13 |
| Pump Station | .07 | --- | .07 |
| Construction Cost | .44 | .76 | 1.20 |
| Contingencies 10% | | | |
| Prof. Serv. 16% | .12 | .20 | .32 |
| Total Capital Cost | .56 | .96 | 1.52 |
| Annual O&M | .03 | --- | .03 |
| Present Worth O&M | .28 | --- | .28 |
| Total Present Worth | .84 | .96 | 1.80 |
| Equivalent Annual Total Cost | 0.09 | 0.10 | .19 |

Alternative P-2

| Cost Item | City Cost (Million $) | Port Cost (Million $) | Total Cost (Million $) |
|---|---|---|---|
| Fprce Mains & Gravity Sewers | .30 | .56 | .86 |
| Pump Station | .15 | --- | .15 |
| Construction Cost | .45 | .56 | 1.01 |
| Contingencies 10% | | | |
| Prof. Serv. 16% | .12 | .15 | .27 |
| Total Capital Cost | .57 | .71 | 1.28 |
| Annual O&M | .03 | --- | .03 |
| Present Worth O&M | .28 | --- | .28 |
| Total Present Worth | .85 | .71 | 1.56 |
| Equivalent Annual Total Cost | 0.09 | 0.08 | .17 |

Table 4-6. Mariposa and 20th Street Alternatives Total Cost
(ENR = 5517, January 1987)

| Mariposa 20th Street | Alternate 1 P-1 | Alternate 1 P-2 | Alternate 2 P-1 | Alternate 2 P-2 |
|---|---|---|---|---|
| Total Construction Cost | 7.16 | 6.97 | 6.05 | 5.86 |
| Total Present Worth | 10.58 | 10.34 | 8.57 | 8.33 |

# CHAPTER 5

## SUMMARY COMPARISON OF ALTERNATIVES

This section presents a comparison of the Mariposa and the Twentieth Street alternatives and results in a recommendation of the Apparent Best Alternative for each drainage area. The evaluation procedure used to compare the final alternatives for this update amendment consists of ranking each alternative against a set of evaluation factors. These factors consist of costs, energy consumption, land requirements, traffic impacts, flexibility, reliability, implementability, and public acceptability.

Recommendation of the Apparent Best Alternative based on any one factor may lead to the adoption of an unacceptable alternative. For, example, the least expensive alternative may be environmentally unacceptable; likewise, the most environmentally sound alternative may be too expensive to implement. Therefore, the importance of each factor is considered. This procedure involves the comparison of a series of trade-offs between the advantages and disadvantages of each alternative against those of the other. Thus, the selection of the apparent best alternative project is based on trade-off considerations which place the preferred alternative over one offering less advantages or greater disadvantages in a majority of the factors considered.

## COMPARISON OF MARIPOSA ALTERNATIVES

Table 5-1 below presents the non-weighted ranking of the Mariposa alternatives against the evaluation factors, with the lower number being the better ranking:

TABLE 5-1 - Comparison of Mariposa Alternatives

| | EVALUATION FACTOR | ALTERNATIVES | |
|---|---|---|---|
| | | ALT. 1 | ALT. 2 |
| 1. | Present Worth Cost | 2 | 1 |
| 2. | Energy Consumption | 1 | 1 |
| 3. | Land Requirements/ Implementability | 2 | 1 |
| 4. | Traffic Impacts | 1 | 2 |
| 5. | Flexibility | 1 | 1 |
| 6. | Reliability | 1 | 1 |
| 7. | Public Acceptability | 2 | 1 |
| | TOTAL | 10 | 8 |

Alternative 2 has an overall non-weighted ranking lower than Alternative 1.

Alternative 1 is basically the same as Alternative 2. The only major difference is that storage in Alternative 1 will be provided by a reservoir situated on private land which will have to be purchased by the City, and storage in Alternative 2 will be provided by a box structure beneath Mariposa Street. Both alternatives will have a new wet-weather pump station and continue to use the existing Mariposa Pump station (modified) for dry-weather flow.

Since both alternatives are so similar, many of the evaluation factors (see Alternatives Analysis) used in the ranking procedure have been rated the same. However, four of the eight evaluation factors (present worth cost, traffic impacts, land requirements/implementability, and public acceptability) have been rated differently and are discussed below.

<u>Present Worth Cost</u>: As presented in Table 4-1 of the Analysis of Alternatives chapter, Alternative 1 has a significantly higher cost than Alternative 2. Therefore, Alternative 2 has the number 1 ranking.

<u>Traffic Impacts</u>: Alternative 2 will have a greater traffic impact than Alternative 1 and is rated second with respect to this evaluation factor. The force main and sewer alignment will be identical for both alternatives, and therefore the traffic impact pertaining to this will also be identical. However, since Alternative 2 will have the box structure constructed within Mariposa Street, instead of on a separate parcel of land as with Alternative 1, it will create greater local traffic disruption, particularly to the concrete batching plant on the north side of Mariposa Street and the bus yard on the southside fronting the box construction.

Land Requirements/Implementability: These two evaluation factors were combined since the implementability of both alternatives depends upon some type of land requirement. Alternative 1 requires the purchase of 0.45 acres of privately owned land, and Alternative 2 requires the acquisition of the right to construct in an area which is under the jurisdiction of the Port Authority. Because similar construction rights have been previously obtained for other facilities located within Port jurisdiction, and since no additional private land is needed, Alternative 2 is ranked above Alternative 1.

Public Acceptability: Although there would be additional short-term traffic impacts with Alternative 2, it should be somewhat more acceptable to the public since it will not require the purchase of private property. Thus, Alternative 2 is ranked above Alternative 1 with respect to this evaluation factor.

MARIPOSA APPARENT BEST ALTERNATIVE

If a weighted ranking system were to be used, cost, traffic impacts and public acceptability (the only factors different for the alternatives) would accentuate the difference in favor of Alternative 2 for cost and for public acceptability. Cost would have a high weight ranking. Alternative 1 ranks better than Alternative 2 in the traffic impacts but the difference is slight; and therefore the weight factor would be low. The weighted traffic impacts factor would not overcome the other three factors where Alternative 2 is superior to Alternative 1.

From the ranking of Alternatives (Table 5-1), Alternative 2 is the Apparent Best Alternative. Alternative 1 was not chosen primarily because of two factors: (1) the capital cost is 33% greater, and (2) it requires the purchase of 0.45 acres of privately owned land.

## COMPARISON OF TWENTIETH STREET ALTERNATIVES

Table 5-2 following presents the ranking of the Twentieth Street alternatives against the evaluation factors. As with the Mariposa alternatives, land requirements and implementability are combined and considered as one evaluation factor for comparison of Alternatives P-1 and P-2.

TABLE 5-2 - Comparison of Twentieth Street Alternatives

| | EVALUATION FACTOR | RANKING OF ALTERNATIVES | |
|---|---|---|---|
| | | P-1 | P-2 |
| 1. | Present Worth Cost | 2 | 1 |
| 2. | Energy Consumption | 1 | 2 |
| 3. | Land Requirements/ Implementability | 1 | 2 |
| 4. | Traffic Impacts | 2 | 1 |
| 5. | Flexibility | 1 | 1 |
| 6. | Reliability | 1 | 1 |
| 7. | Public Acceptability | 1 | 1 |
| | TOTAL | 9 | 9 |

Alternatives P-1 and P-2 are similar with respect to function and alignment. The major difference between them is the location of the pump station and storage facility. In Alternative P-1, the pump station and storage sewer will be located in City street at the easterly end of Twentieth Street, With Alternative P-2, however, the pump station will be located in Port property at the intersection of Twentieth Street and Delaware Street extended, and storage will be provided by the proposed 66-inch diameter sewer connecting the Twentieth Street sewer and all other storm sewers on Port property which discharge to the Bay.

Because both alternatives are so similar, they are ranked equally with respect to certain evaluation factors (flexibility, reliability, and public acceptability). The remaining factors have been ranked differently for each alternative and are discussed below.

<u>Present Worth Cost</u>: As presented in Table 4-5 in Chapter 4 P-1 has a greater overall cost to the Clean Water Program and the Port.

<u>Energy</u>: Alternative P-2 would pump the same flow as Alternative P-1 but it would pump from a slightly lower elevation and would have a somewhat longer force main, requiring additional energy use. However, this additional energy use is considered to be negligible.

<u>Traffic Impacts</u>: The sewer and force main construction in City streets is almost identical for each alternative. For Alternative P-2, additional traffic impacts would occur on Port property for the sewer and force main construction but these impacts would affect only Port operations. The impacts can be reduced by cooperation and coordination with the Port during construction.

In Alternative P-1, the pump station and storage sewer will be located near the easterly end of 20th Street. This street provides access for vehicles to the Port facilities. If this alternative was implemented, traffic movement at this site would be impeded somewhat during construction of these facilities. For this reason, P-2 was ranked superior to P-1.

<u>Land Requirements/Implementability</u>: For each alternative, construction on property belonging to the Port of San Francisco is required if all the elements are to be constructed.

Alternative P-1, however, can be broken down into two separate portions: elements located in City street and those located on Port property. The elements located within City street would be the pump station, storage sewer, and force main. These facilities can function separately and handle flows from a portion of the Twentieth Street subbasin. Depending upon a decision by the Port Authority, the remaining sewers could be constructed at a later date and tied into City facilities. Upon completion of these remaining elements, storm flow for the entire subbasin would be controlled.

In order for Alternative P-2 to function, the entire project must be constructed. Therefore, for this alternative, a decision by the Port Authority must be made to allow construction on its property.

TWENTIETH STREET APPARENT BEST ALTERNATIVE

Because of the issues discussed above, final selection of a Twentieth Street solution cannot be made until after detailed negotiations with the Port of San Francisco. For purposes of this report update amendment both P-1 and P-2 will be carried forward as Apparent Best Alternatives for this drainage area.

Alternative P-2 has the least total cost and has slightly less construction impacts than Alternative P-1. However, from the standpoint of the Clean Water Program, Alternative P-1 must be supported as the ABA because: (1) decisions to be made by the Port are unknown at this time, and (2) if the Port refuses construction of the gravity sewers located on their property, the pump station, force main, and storage sewer can be built in 20th Street without Port agreement. The sewers on Port property could be built and tied in to these facilities at a later date, when future storm water regulations would require such construction.

In conclusion, P-1 and P-2 are considered the Apparent Best Alternatives for the Twentieth Street subbasin, and the determinations of which will be constructed will depend upon future negotiations with the Port.

# CHAPTER 6

## APPARENT BEST ALTERNATIVE

This chapter presents the Apparent Best Alternatives which have been developed and analyzed in the previous chapters for the Mariposa and Twentieth Street drainage areas.

### Facility Sizing

As was discussed in Chapter 3, Development of Alternatives, Facility Sizing Update, the rate of flow and the quantity of flow is somewhat greater than was stated in the Master Plan. This is primarily due to including some Port of San Francisco land that was not considered in the master plan and also because of a slight change in the runoff coefficient. This project will not increase the sewer capacity.

### Mariposa ABA - Alternative 2

In order to reduce the existing overflows to the Bay in the area of the Mariposa subbasin, a 1.3 MG transport/storage box with an internal 6 MGD pump station is proposed. See Figure 6-1. The existing Mariposa Pump station will be refurbished and used for dry-weather flow. (See Table 6-1).

### Dry-weather flow system:

Dry-weather flows in the Mariposa area follow their existing routes to Mariposa Street where they are connected to the proposed transport/storage box. The existing 3'-0" x 4'-6" sewer which directs flow eastward at the intersection of Mariposa and Third and the 3'-0" x 4'-6" and the 24" sewers which direct flows southward and northward on Illinois to Mariposa Street are connected to the box structure.

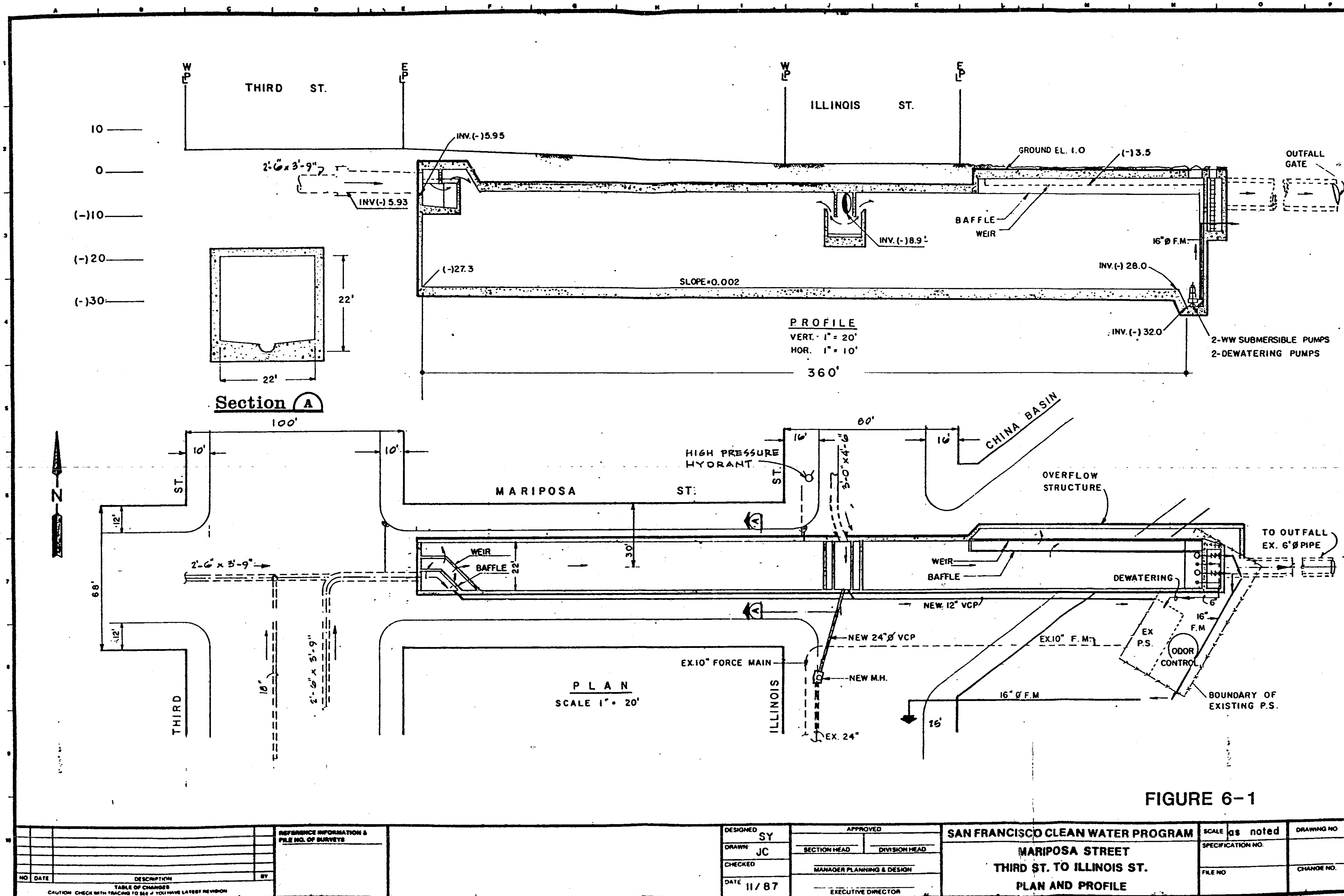

THIRD ST.
ILLINOIS ST.
10
0
(-)10
(-)20
(-)30
INV.(-)5.95
2'-6" x 3'-9"
INV(-) 5.93
GROUND EL. 1.0
(-)3.5
OUTFALL GATE
BAFFLE
WEIR
INV. (-)8.9
16" Ø F.M.
INV.(-) 28.0
(-)27.3
SLOPE=0.002
22'
PROFILE
VERT. 1" = 20'
HOR. 1" = 10'
INV.(-) 32.0
2-WW SUBMERSIBLE PUMPS
2-DEWATERING PUMPS
360'
Section A
100'
10'
80'
16'
CHINA BASIN
HIGH PRESSURE HYDRANT
3'-0" x 4'-6"
MARIPOSA ST.
OVERFLOW STRUCTURE
TO OUTFALL EX. 6' Ø PIPE
N
12'
30'
68'
WEIR
BAFFLE
DEWATERING
NEW 12" VCP
6"
16" F.M
EX P.S.
ODOR CONTROL
NEW 24" Ø VCP
EX.10" F.M.
EX.10" FORCE MAIN
NEW M.H.
16" Ø F.M
15"
BOUNDARY OF EXISTING P.S.
18"
PLAN
SCALE 1" = 20'
THIRD
ILLINOIS
EX. 24"
NO DATE DESCRIPTION BY
TABLE OF CHANGES
CAUTION: CHECK WITH TRACING TO SEE IF YOU HAVE LATEST REVISION
REFERENCE INFORMATION & FILE NO. OF SURVEYS
DESIGNED SY
DRAWN JC
CHECKED
DATE 11/87
APPROVED
SECTION HEAD
DIVISION HEAD
MANAGER PLANNING & DESIGN
EXECUTIVE DIRECTOR
SAN FRANCISCO CLEAN WATER PROGRAM
MARIPOSA STREET
THIRD ST. TO ILLINOIS ST.
PLAN AND PROFILE
SCALE as noted
SPECIFICATION NO.
FILE NO
DRAWING NO
CHANGE NO.

FIGURE 6-1

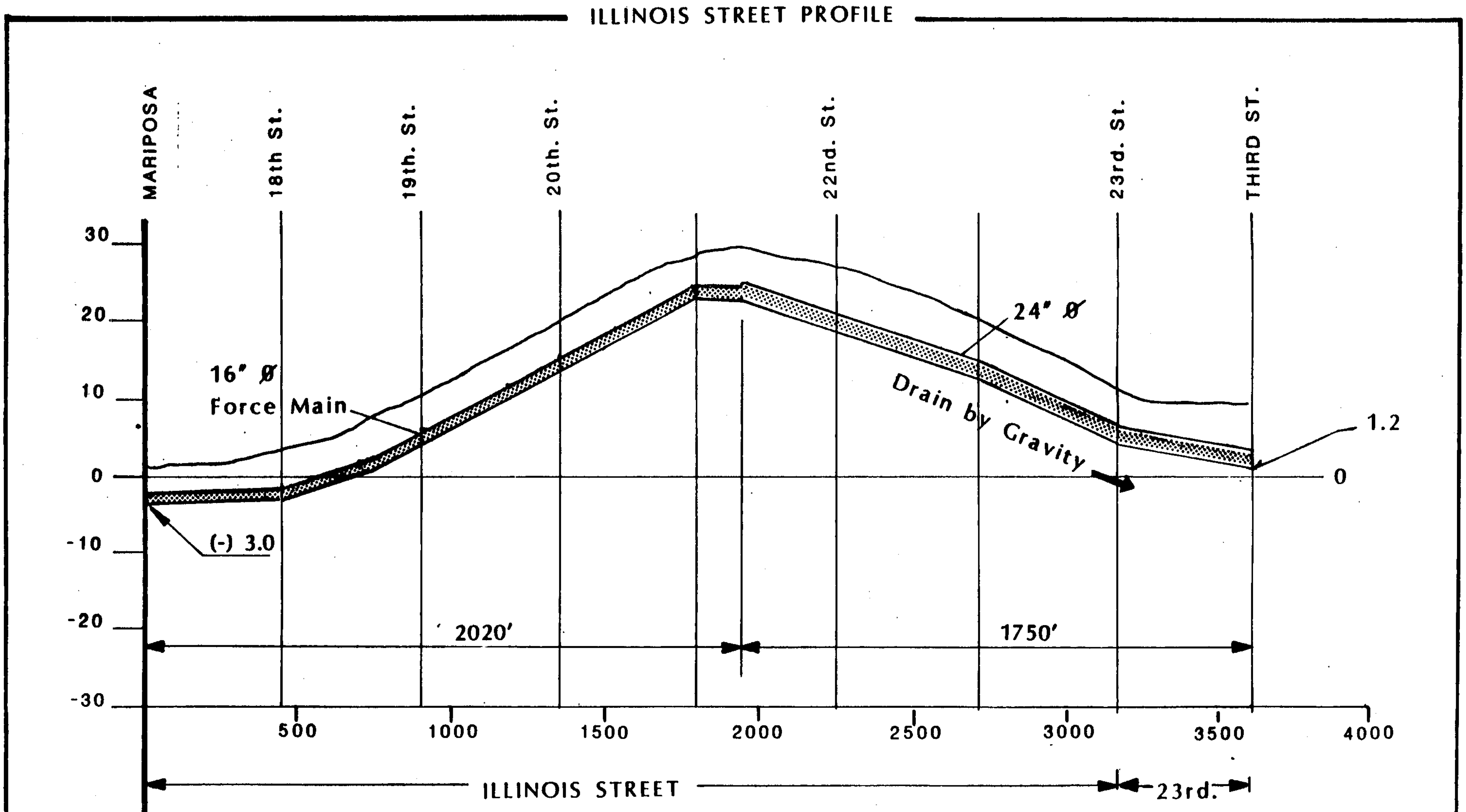

ILLINOIS STREET PROFILE
MARIPOSA
18th St.
19th. St.
20th. St.
22nd. St.
23rd. St.
THIRD ST.
30
20
10
0
-10
-20
-30
16" Ø
Force Main
24" Ø
Drain by Gravity
1.2
0
(-) 3.0
2020'
1750'
500
1000
1500
2000
2500
3000
3500
4000
ILLINOIS STREET
23rd.

FIGURE 6-2

From these connections, the dry-weather flow bypasses through the box in segregated channels to a new 12" sewer located along the southside of the box and drains to the refurbished Mariposa Pump Station. The flow is then pumped through the existing 10" force main along Illinois Street to 21st Street where it is intercepted by a new 24" gravity sewer, which conveys the flow to an existing 3'-0" x 4'-6" sewer connection at 23rd and 3rd Streets. See Fig. 6-2. From here the dry-weather flow gravitates to the SEWPCP for treatment.

Table 6-1. Major Elements - Mariposa ABA

ALT 2 - Transport/Storage Box

| Element | Location | Dimension | Capacity Length |
|---|---|---|---|
| Transport/Storage Box | Mariposa St. from Existing Mariposa P.S. to 3rd St. | L = 360'<br>W = 22'<br>D = 22' Ave. | 1.30 MG |
| Wet Weather P.S. | East end of T/S box | | 6.0 MGD |
| Refurbished dry-weather P.S. | Site of existing P.S. | | 1.35 MGD |
| 16"Ø Force Main | Mariposa St. - P.S. to Illinois; Illinois St. - Mariposa to 21st St. | | 2020' |

| Element | Location | Dimension | Capacity Length |
|---|---|---|---|
| 24"Ø Sewer | Illinois St. - 21st St. to 23rd St.; 23rd St. -Illinois to 3rd St. | | 1750' |

<u>Wet-weather flow system</u>:

Combined storm and sewage flows would follow the dry-weather route to the channels within the transport/storage box as described above. Flow in excess of dry-weather amounts will overflow weirs provided along these channels and fall into the box. From here, the flow gravitates eastward within the box to the new wet-weather pump station where it is pumped through a new 16" force main along Illinois Street to the new 24" sewer beginning at 21st Street extended. The flow is then transported to the SEWPCP as in the dry-weather system discussed above. See Fig. 6-2. When the box storage capacity is exceeded and the water level reaches an elevation of approximately (-)3.5 feet, flow is directed over a weir (60 foot in length) through an overflow structure to the existing 72" diameter Mariposa outfall to the Bay.

<u>Mariposa dry-weather pump station</u>:

The two existing centrifugal pumps, motors, extension shafts, check valves and gate valves shall be removed, along with their support structures and replaced with two new submersible pumps, (one pump will be a back-up) along with individual variable frequency drives and new valves. Each pump has a minimum capacity of 1.35 MGD and will satisfy the demand for a peak dry-weather flow of 1.26 MGD. The pumps shall be installed in the pump dry well as indicated in Fig. 6-3.

The existing 10" force main in Illinois Street will continue to be used for dry-weather flow.

The wet well will be re-shaped to decrease the sump storage volume and thereby diminishing the odor problem. In addition, activated carbon filters will be installed on vented air outlets to further eliminate any potential odor from dry-weather operation.

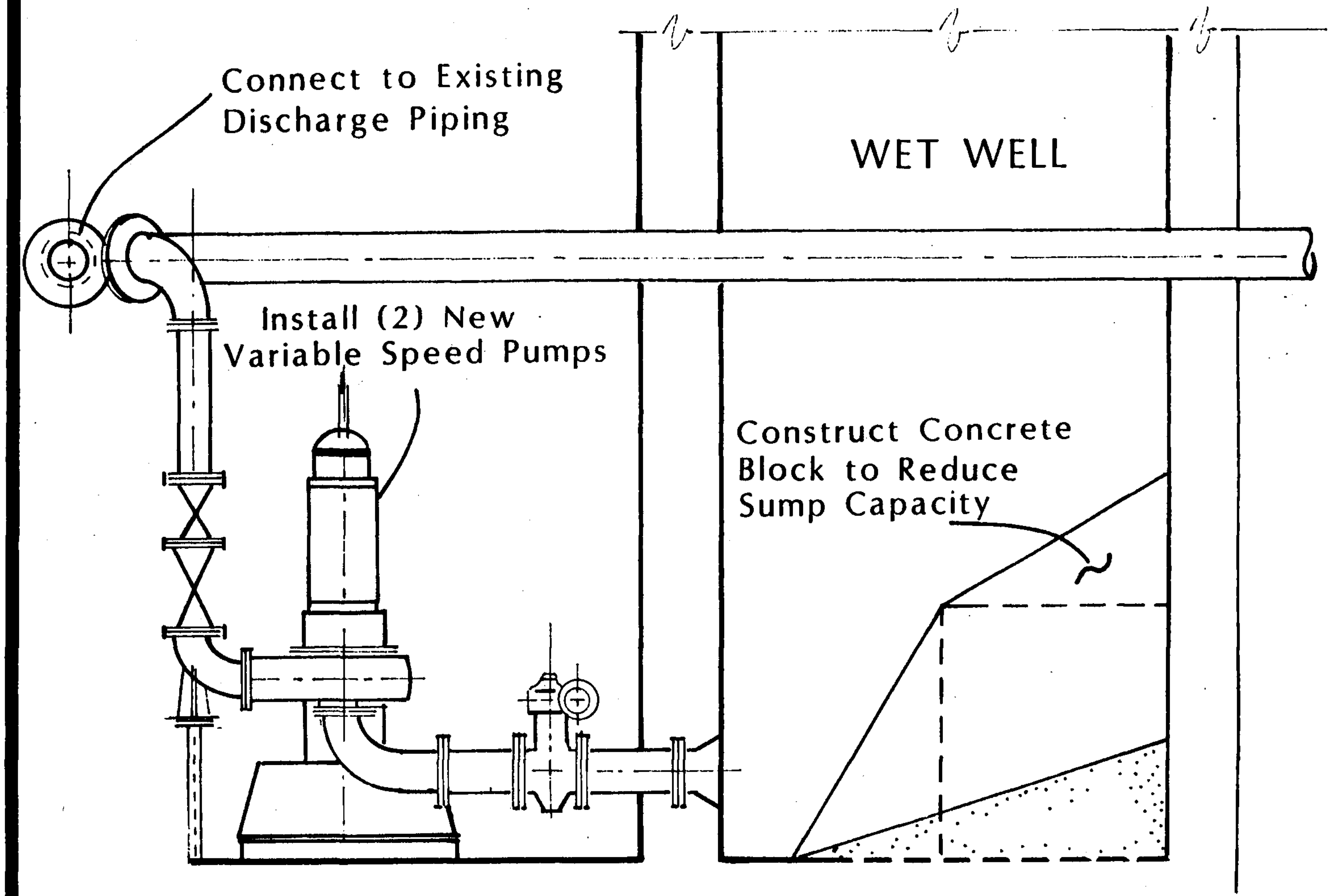
The submersible pump recommended would be 940 gpm capacity and a Total Dynamic Head (TDH) of 52 feet, which would require a 20 hp, 230 v, 60 hz, 3Ø electric motor.

If the pump station fails or when the capacity is exceeded during rainy weather, overflow to the wet-weather transport/storage box will occur and the wet-weather pump station will respond.

Each pump shall be sequenced to provide unequal wear. A 10" Magnetic Flow Meter shall monitor and record the flow.

Mariposa wet weather pump station:

The wet-weather pumps will be located underground at the east end of the Mariposa Transport/Storage Box. The main pumping equipment shall consist of two 12" submersible constant speed pumps, each delivering 5 MGD at a TDH of 65'. These shall be connected in parallel to give a maximum flow of 6.2 mgd. A 12" magnetic flow meter shall monitor this flow which shall be recorded at the Control Board in the dry-weather pump Station. The size of the force main shall be 16". It shall be constructed in Illinois Street and connected to a new 24-inch gravity sewer in Illinois Street beginning at 21st Street extended.




MARIPOSA DRY WEATHER PUMPING STATION
MODIFICATIONS

FIGURE 6-3

When the capacity of the transport box is exceeded, wet-weather flow overflows a weir at elevation -3.5 (required to keep out tide water) and enters the Bay through the existing 72" diameter outfall sewer.

The wet-weather station will also contain two (2) dewatering pumps connected in parallel to pump out the sewage in the box when the larger pumps cannot pump at the lower water levels. The dewatering pumps would pump to the dry-weather station wet well. Each of these 5 hp dewatering pumps will have a capacity of 400 gpm at a TDH of 32 feet. Both pumps shall be on 460 v, 3Ø, 60 HZ. The electrical control panel for the wet-weather station will be installed in the existing Mariposa Dry-Weather Pump Station.

Both the wet-weather and dewatering pumps shall be removable by a truck crane from the yard level for maintenance and repairs.

Odor control and safety shall be maintained by continuous monitoring at both the station and the T/S box for hydrogen sulfide ($H_2S$) oxygen deficiency, and hazardous gases. Alarms shall indicate hazardous conditions.

Provisions shall be made to washdown the T/S box by means of fire hoses. A water supply line with three hose connections would be installed in the ceiling of the box so that the box can be washed manually after storms.

A valve vault (7' deep) is to be provided at the end of the transport structure with waterproof covers to house the check valves and control valves.

Twentieth Street Subbasin ABA's - Alternatives P-1 and P-2

In the case of the Twentieth Street alternatives, there are no separate dry-and wet-weather systems.

In Alternative P-1, flow in the existing sewer along Twentieth Street will continue to gravitate easterly until it is intercepted by a new control structure near the easterly end of Twentieth Street at Louisiana Street extended. Storm flow from a 24" diameter Port storm sewer near 22nd Street, which now drains to the Bay, will be transported northward and westward by new 42" and 48" diameter gravity sewers until reaching the control structure. Flow entering this structure will be diverted into the new adjacent 3 MGD package pump station. Storage will be provided by the 42" and 48" sewers and also by a new 7' diameter sewer which will replace approximately 200' of the existing 18" sewer along Twentieth Street. When the storage/pumping capacity of this system has been reached, the excess flow will overflow a weir within the control structure and enter an existing 21" Twentieth Street Outfall Sewer. This sewer will transport the flow eastward for disposal into the Bay. (See Fig. 3-9).

In Alternative P-2, flow in the existing 18-inch diameter sewer along Twentieth Street will continue to flow easterly from Twentieth and Delaware Streets into Port property until it is intercepted by a new control structure situated at the intersection of Twentieth and Delaware Streets extended, near the SF Bay shoreline. Storm flow from the 24-inch diameter Port sewer, which drains to the Bay, will be intercepted and transported northward via a new 66" diameter sewer to the previously mentioned control structure. Flow entering this structure will be diverted into the new 3 MGD package pump station also located at this site. Storage will be provided by the new 66" sewer. When the storage capacity of this system has been reached, the excess flow will overflow a weir within the control structure and enter the existing Twentieth Street Outfall sewer. (See Fig. 3-10.)

In both Alternatives P-1 and P-2, the new 3 MGD package pump station will pump flow through a new 10" force main eastward along Twentieth Street and southerly along Illinois Street until it is intercepted by the new 24" sewer described for the Mariposa ABA. The existing pump station, diversion structure, and 6-inch force main will ultimately be removed.

The new pump station will be a 3 MGD prefabricated facility complete with all equipment factory-installed in a welded steel chamber. For a pumping rate of 3 MGD, two pumps each rated at 2,100 gallons per minute, or three pumps rated approximately 1,050 gallons per minute would be provided. (See Fig. 6-4).

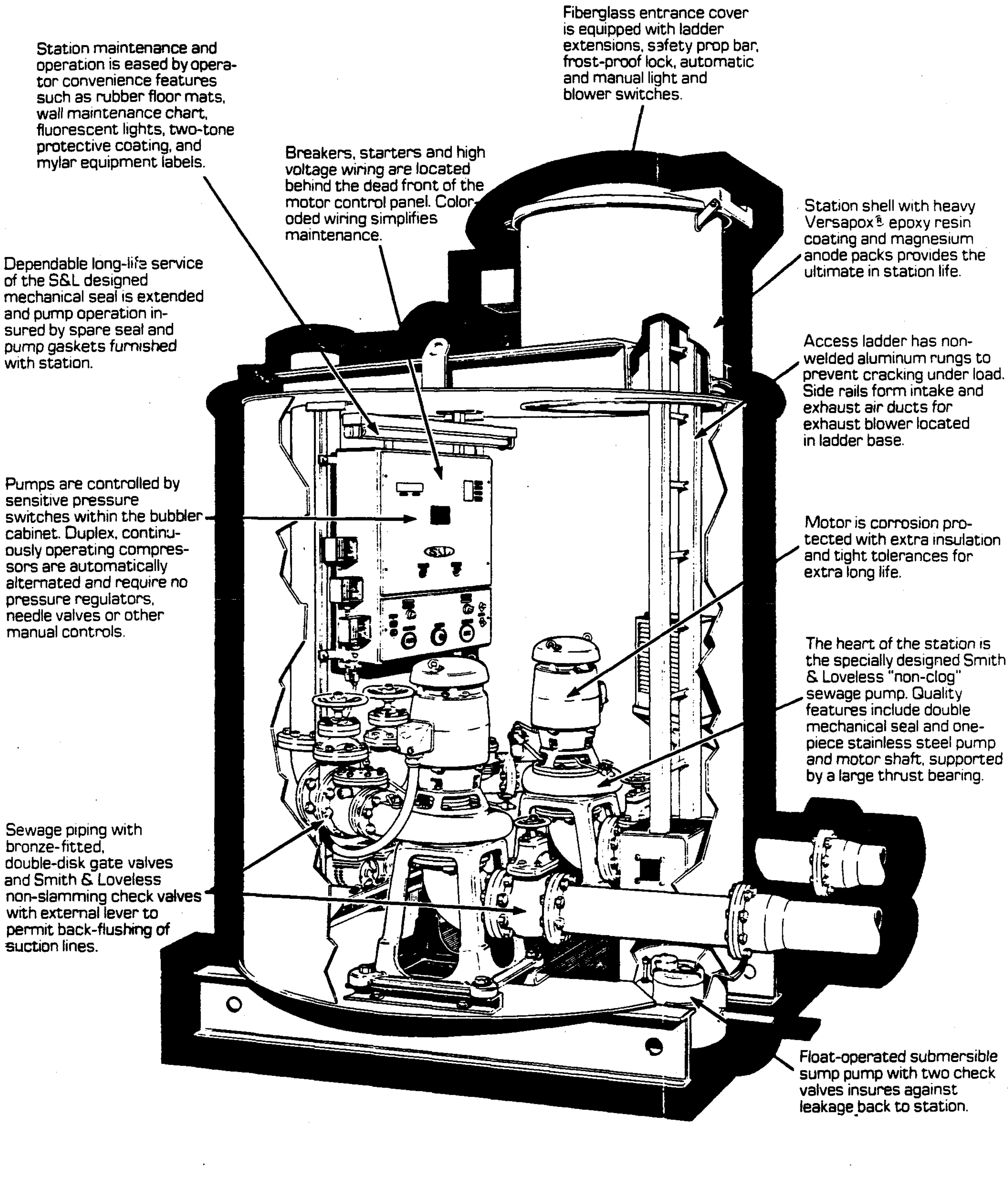

Station maintenance and operation is eased by operator convenience features such as rubber floor mats, wall maintenance chart, fluorescent lights, two-tone protective coating, and mylar equipment labels.
Fiberglass entrance cover is equipped with ladder extensions, safety prop bar, frost-proof lock, automatic and manual light and blower switches.
Breakers, starters and high voltage wiring are located behind the dead front of the motor control panel. Color-coded wiring simplifies maintenance.
Station shell with heavy Versapox® epoxy resin coating and magnesium anode packs provides the ultimate in station life.
Dependable long-life service of the S&L designed mechanical seal is extended and pump operation insured by spare seal and pump gaskets furnished with station.
Access ladder has non-welded aluminum rungs to prevent cracking under load. Side rails form intake and exhaust air ducts for exhaust blower located in ladder base.
Pumps are controlled by sensitive pressure switches within the bubbler cabinet. Duplex, continuously operating compressors are automatically alternated and require no pressure regulators, needle valves or other manual controls.
Motor is corrosion protected with extra insulation and tight tolerances for extra long life.
The heart of the station is the specially designed Smith & Loveless "non-clog" sewage pump. Quality features include double mechanical seal and one-piece stainless steel pump and motor shaft, supported by a large thrust bearing.
Sewage piping with bronze-fitted, double-disk gate valves and Smith & Loveless non-slamming check valves with external lever to permit back-flushing of suction lines.
Float-operated submersible sump pump with two check valves insures against leakage back to station.

**FIGURE 6-4**

## Cost Estimates

Cost estimates for the Mariposa T/S Alternative and 20th Street Alternative P-1 and P-2 are presented below:

Table 6-1a. Mariposa T/S And 20th Street Alternatives Cost Estimate
(ENR = 5517, January 1987, in Million $)

| | Mariposa T/S And 20th Street Alternatives | |
|---|---|---|
| | P-1 | P-2 |
| Transport/Storage Structure | 2.96 | 2.96 |
| Mechanical (Pumps, Odor Control & Flushing) | 0.80 | 0.88 |
| Force Mains & Gravity Sewers | 2.29 | 2.02 |
| Construction Cost | 6.05 | 5.86 |
| Contingencies (10%) plus Professional Services (16%) | 1.58 | 1.53 |
| Total Capital Cost | 7.63 | 7.39 |
| Annual O&M | 0.10 | 0.10 |
| Present Worth O&M | 0.94 | 0.94 |
| Total Present Worth | 8.57 | 8.33 |
| Equivalent Annual Total Cost | 0,91 | 0.89 |

Construction Methods

The ground conditions in the area change rapidly over relatively short distances. Some areas consist of 5 to 25 feet of artificial fill, soft silty clay (younger bay mud), interbedded layers of silty/clayey sand with stiff silty clay (older bay mud), and bedrock of the Franciscan Formation. Groundwater is generally at an elevation of approximately -9 SFCD.

Open excavations:

The Mariposa transport/storage facility will be underlain by bay mud; therefore, site excavation will be through fill and younger bay mud. Excavation within the Twentieth Street area will be mostly in fill with possibly some bay mud excavation. The excavation for the force main/gravity sewer along Illinois and Third Streets will be in fill, younger bay muds, sand/gravelly deposits (colluvium), and serpentinite and graywacke bedrock of the Franciscan Formation, for varying distances.

It is expected that excavation of the fill and the sandy/gravelly deposits will be relatively easy and can be done by conventional means unless obstructions, such as rubble, concrete blocks or industrial debris, are encountered in the fill. The younger bay mud may require special handling during excavations and may be inadequate as a working surface due to its high moisture content and plasticity. It may be necessary to overexcavate the bay mud and any other weak material and replace it with granular fill or crushed rock and filter fabric to provide both an adequate working surface and adequate support.

Although the rock in the general area is weathered, fractured, and crushed, competent serpentinite may be encountered which will be harder to excavate. Thus, in addition to conventional means, rock excavation may require use of heavy ripping or jackhammering.

Trench sides will have to be retained by a temporary support system. Since the fill to be supported along most of the excavation length consists mainly of cohesionless soils and the groundwater level is near ground surface, steel sheet piling appears to be the most suitable support system. Rock bolts and/or a tie-back system will probably be needed to support vertical cuts in rock.

The walls of the bracing system will be subject to lateral pressures. These pressures will depend on the type of earth material, type of bracing system, excavation depth, construction sequence, and dewatering method.

Foundation Support

All of the anticipated soil and rock types directly below the 16-inch, 24-inch, and 10-inch sewers should be capable of supporting the expected pressure without any bearing problem. The bay mud and some of the fill will not be capable, of supporting the larger pipes within the Twentieth Street area. A special foundation may have to be used to transfer the pressures to a stronger layer beneath. If the pipe is underlain by fill, and more than 4 feet separates the bottom of the pipe from the bay mud surface, a possible solution would be to compact the local zones of loose fill to obtain the required bearing capacity. The transport/storage box structure will be underlain by the younger bay mud which will not be capable of supporting the proposed structures and deep foundations (piles) will be required.

Some areal settlement may be continuing due to the consolidation of the bay mud in areas where it is overlain by artificial fill. The amount of the remaining areal settlement, if any, depends on the date of fill placement, the thickness of the fill, and the thickness of the bay mud. In areas where a large amount of continuing settlement is expected, the proposed structure may have to be supported on a deep foundation to maintain the required gradient.

Settlement may be reduced appreciably by adopting one or both of the following methods:

1. Support the structure by either end-bearing or friction piles. An additional downdrag load on the piles due to the continuing areal settlement of the clay and possible uplift forces on the piles due to buoyancy of the structure should be included in the design of the piles.
2. Reduce the imposed structural pressure to an amount less than the original in-place soil pressure which may be the case with the T/S box. Lightweight aggregate may be used as bedding material if needed.

Uplift pressure on the transport/storage structure, when empty, is a problem which must be considered and either tie down piles or thick mat foundation may be needed to resist this pressure. Careful and controlled construction and dewatering procedures should be followed to reduce the amount of settlement caused by construction. It is very important not to disturb the sensitive younger bay mud. Granular backfill and filter fabric should be carefully placed to fill and compact the voids left by the removal of the temporary supporting system.

Dewatering

Since most of the deep excavations required will be in fill overling bay mud and the groundwater level is relatively high, a positive dewatering system should accompany the excavation in order to ensure a workable surface and allow for satisfactory construction. A well-point system appears to be suitable for the conditions expected, and sump pumps may be needed for excavation into bedrock and clays.

Traffic Considerations

The streets affected by construction of the Apparent Best Alternatives are Mariposa, Third, Twenty-Third, Illinois, and Twentieth Streets. Major intersections which would be disrupted are Illinois/Mariposa Streets and Third/23rd Streets. The Illinois/Mariposa intersection, affected by the T/S box, could be closed or traffic required to share use of only one lane on each street. Staging of construction or bridging the excavation may be required to keep traffic active through the intersection. Closure would require a circuitous detour to reach China Basin Street. The Third/23rd Streets intersection has heavy peak period traffic along Third Street. Although alternative routes exist, the intersection cannot be closed to north/south traffic without severe congestion and bridging of the intersection may be required. For detour routing and a more indepth traffic analysis, see the Mariposa Facilities Traffic Study.

## Haul Routing

Hauling of spoils and materials to and from the project area would follow the most convenient streets in accessing a freeway capable of handling haul vehicle traffic in the desired direction. Freeway access to the project sites in this area may be made via local street routing. Outbound and inbound haul routing options are covered in the Mariposa Facilities Traffic Study.

## Solids Management

In order to identify solids management strategies for the Bayside Facilities, a review was conducted of the operation and performance of existing wet-weather transport and storage facilities. Information on solids transport, deposition and resuspension was obtained for various facilities throughout the country and in San Francisco. Based on this information, general details and costs were developed for the operation and maintenance of transport/storage facilities.

Solids present in wet-weather flow consist of grit, screenings, and scum. It is recommended that solids be contained as much as possible within the sewer system and conveyed to treatment plants for removal and disposal. Grit may tend to settle in T/S facilities due to reduced flow velocity. Grit would be resuspended after settling by flushing the facilities with fresh water. After resuspension, the grit would be transported to the treatment facilities for removal and disposal.

## Operation and Maintenance

The continuing successful performance of the Mariposa and Twentieth Street facilities will rely on a good operation and maintenance program.

Most of the operational requirements for the apparent best alternatives are associated with the new Mariposa and Twentieth Street pumping stations. These operations will vary significantly with the season.

Regular inspection and maintenance will be required by operating personnel during dry weather. The dry-weather season is the best time to perform major maintenance on wet-weather pumps and associated equipment since they will not need to be placed in service on short notice.

The use of electric motors to drive all the pumps eliminates the problem of frequent exercise that would be required to keep internal combustion engines ready for service. Electric drives also require a minimum of maintenance for wear.

The operations and maintenance of the facilities will be the responsibility of the Department of Public Works, Bureau of Water Pollution Control. Personnel requirements will be greater during wet-weather months than dry-weather months. No permanent on-site personnel will be assigned to the facilities at any time; existing roving crews will periodically inspect the facilities.

Revenue Plan

The San Francisco Clean Water Program is responsible for financial planning for each project of the City's wastewater program. The financial plan and revenue program is described in the Official Statement City and County of San Francisco Relating to $146,240,000 Sewer Refunding Bonds, Series D dated April 17, 1986, prepared by Paine Webber & Co., Inc., and the 1987 Clean Water Enterprise Revenue Plan, June 1987, prepared by the Department of Public Works.

It is projected that the Clean Water Grant Program in California will end September 30, 1988 and the State will have a loan program for completion of eligible Clean Water projects. It is anticipated that low percentage rate loans will be available for eligible construction costs. The City must finance all ineligible costs and cash flow requirements during construction. The City plans to meet its funding requirements and loan repayment from three sources: (1) available unencumbered funds; (2) net proceeds from the sale of portions of a $240 million Sewer Revenue Bond authorization approved by the electorate on November 2, 1976; and (3) income from the investment of Sewer Revenue Bond proceeds during construction.

Sewer Revenue Bonds are issued pursuant to Resolution No. 973-77 of the Board of Supervisors. Section 6.15 of that Resolution provides that the City shall set charges for services of the sewerage system so as to yield net revenues in each fiscal year equal to at least 1.25 times debt service due in that year.

Sewer service charge procedures, in compliance with the State Water Resources Board Revenue Program Guidelines, were adopted in June 1977 and approved by the Environmental Protection Agency. Sewer Service charges are subject to annual review and update, as required by law. The current sewer service rates, and system-wide operations, maintenance and debt service costs are described in detail in the 1987-88 Clean Water Enterprise Revenue Plan. The 1987-1988 Clean Water Enterprise budget provides a debt coverage ratio of 1.39.

## Public Participation

The City is preparing the Public Participation Program for this project. The Public Participation Program will be similar to Programs previously approved by the SWRCB.

## Schedule

The tentative schedule for implementation is shown on Table 6-2. Realistically, it represents the best available scheduling information at this time and is dependent upon the availability of State loan funds at the proper time.

APPENDIX

A CHAPTER 2 - EXCERPT OF BAYSIDE FACILITY PLAN, NORTH BAYSIDE PROJECT REPORT, MARCH 1982, "SUMMARY AND RECOMMENDATION"

B MARIPOSA FACILITIES, ADDITIONAL STORE/PUMP COMBINATIONS

C MARIPOSA FACILITIES TRAFFIC STUDY, FEBRUARY, 1988

D BAYSIDE FACILITIES PLAN, EXPANDED GEOTECHNICAL INVESTIGATION ELEMENTS: MARIPOSA TRANSPORT/STORAGE FACILITY, AUGUST, 1982

PROJECT REPORT, MARCH 1982

# CHAPTER 2

## SUMMARY AND RECOMMENDATIONS

The North Bayside Project consists of the North Shore Transport Facility, the Channel-Islais Transport Facility, and the Mariposa Transport/Storage Facility. These three elements of the Bayside Facilities Planning Project are located north of Islais Creek. In Stage II, all dry weather flow and part of the wet weather flow are transported to the Islais Creek basin, while the remaining 140 mgd of wet weather flow is treated at the North Point Water Pollution Control Plant (WPCP). In Stage III, all flows will be transported to the Islais Creek basin.

The level of control for combined sewer overflows has been set at four overflows per year from the North Shore basin and ten overflows per year from the Channel basin (including the Mariposa subarea). This level is specified by the California Regional Water Quality Control Board (RWQCB), San Francisco Bay Region, in National Pollutant Discharge Elimination System (NPDES) Permit No. CA0038610, dated June 19, 1979 (see Appendix C). Controlling overflows to this level is considered necessary in order to protect the receiving water quality along the shore from Aquatic Park on the north to Islais Creek Channel on the south. There are now seven combined sewer overflow points along the north shore between Baker Street and Jackson Street, where overflows must be reduced to four per year, and 12 overflow points between Howard Street and Twentieth Street, where overflows must be reduced to ten per year. Refer to Figure 1-1 for the locations of these outfalls, numbered 9 through 30 inclusive.

In order to provide the level of protection specified in the NPDES Permit, a study was made of a combination of storage of wet weather flow peaks and conveyance of wet weather flows to the North Shore and Islais drainage basins in Stage II, and the conveyance of combined wet weather flows to the Islais Creek area in Stage III. The conveyance of flows out of basins is termed transport and the combination of storage and conveyance is termed transport/storage throughout the planning process.

A number of alternatives were identified early in the study which satisfy the transport/storage concept. These range from high rates of pumping and conveyance out of the drainage basins, with correspondingly low storage requirements, to large storage reservoirs within the basins, with low withdrawal rates. Transport modes range from tunnel or large gravity conduits to shallow pressure pipelines (force mains). Storage options range from reservoirs located in sites off-line from conveyance elements, to in-line storage under public streets or rights-of-way. A variety of routes and sites were studied in the initial planning effort and are documented in the Bayside Facilities Plan, Interim Report (Reference 7).

## ANALYSIS OF ALTERNATIVES

Thirty-two different alternatives were originally identified for the North Bayside Project, including fifteen low level tunnel alternatives. The initial alternatives were reduced to three for the North Shore Transport Facility, two for the Channel-Islais Transport Facility, and four for the Mariposa Transport/Storage Facility. The tunnels were found to be prohibitively expensive, while storage options were limited by the lack of available suitable land. The initial alternatives were reduced by a screening process that also evaluated both monetary and nonmonetary costs. This portion of the planning effort is documented in the Interim Report. The nine final alternatives are described in detail and analyzed in Chapter 3 of this report in accordance with state guidelines for planning wastewater facilities.

### North Shore Transport Facility

The three final alternatives for the North Shore drainage basin are (1) a new force main connecting the North Shore Pump Station to the Channel Outfall Consolidation facility with an open-cut segment in the Embarcadero, (2) a new force main similar to the first alternative but with the open-cut segment installed along the bay side of the existing seawall, and (3) a high-level gravity conduit connecting the North Shore Outfall Consolidation facility to the Channel Outfall Consolidation facility.

During the analysis of final alternatives in Chapter 3, the concepts of Stage II and Stage III construction became important (see Function of Facilities in Chapter 1). Because of the use of the North Point WPCP in Stage II, it became necessary to provide a Stage II Channel to the North Shore Transport system. This is a temporary system and is described under the North Shore Transport Facility section.

Stage III Pump Station and Force Main Alternative 31A. In this alternative, the new North Shore Pump Station (construction completed November 1981) would be utilized to pump wet weather flows through a new 48-inch-diameter force main to the Channel Outfall Consolidation facility. Surge control would be provided by a new surge tower or inertia wheels at the pump station. Approximately 4,300 feet of the new force main's 8,100-foot total length would be installed within the North Shore Outfall Consolidation facility. The remainder would be installed using open-cut construction in the Embarcadero and Folsom Street.

Stage III Pump Station and Force Main Alternative 32. The function of this alternative is the same as that of Alternative 31A. The major difference is in the route of the 48-inch force main after it leaves the existing North Shore Outfall Consolidation facility. It would pass through the seawall near Pier 5 and then proceed southeast along the bay side of the Embarcadero, passing under Piers 1, 3, and 5, the Ferry Building, and the Agriculture Building. The new force main would also have to be constructed about 150 feet offshore to avoid interference with the new Promenade currently under construction near Pier 14.

Stage III High-Level Gravity Conduit Alternative 33. This alternative consists of a high-level gravity connection between the existing North Shore and Channel Outfall Consolidation facilities. The conduit would be a 10-foot wide by 8-foot deep box or a 10-foot-diameter pipe. The concept of Alternative 33 is that prior to any overflows at North Shore, some of the flow would be intercepted by the gravity connection and transported to the Channel basin. This alternative was analyzed, utilizing the existing controlled storage at the North Shore and Channel basins. Wet weather pumping would not be required at North Shore, and a lesser withdrawal rate would be needed at Channel. This alternative involves a major construction support problem at the point where the required large conduit passes under the BART relieving structure. Also, the NPDES requirement of four overflows per year would be violated at the Jackson Street Outfall.

Alternatives 31A and 32 are sized as 48-inch-diameter pipes to transport 80 mgd of wet weather flow from the North Shore basin to the Channel basin, as required to eliminate the North Point WPCP effluent discharge to the bay during wet weather and to reduce combined sewer overflows to a level of four per year. Alternative 33 is sized as a 10-foot-wide by 8-foot-deep box or a 10-foot-diameter pipe to connect the two drainage basins so that their storage volumes act as one. Considerable discussion is presented in Chapter 3 dealing with the functioning of this gravity alternative. None of the alternatives (31A, 32, and 33) will be required until Stage III.

Stage II Channel to North Shore Transport System. This is a temporary system required to divert 45 million gallons per day (mgd) of wet weather flow from the Channel basin to the North Shore basin for treatment at the North Point WPCP. Conveyance of this flow is essential to achieve an overflow control level of ten events per year in the Channel basin during Stage II. There are several ways to accomplish this diversion. The method selected is common to all final North Shore Transport facilities and consists of a series of flow diversions along the North Point main and the upgrading of the existing Fourth Street Pump Station and force main. The Channel to North Shore Transport System is required for Stage II operation and is included in the cost estimates for the other three alternatives.

## Channel-Islais Transport Facility

One of the two final alternatives is required for Stage III to transport the wet weather flows from the Channel tributary area, including inputs from the North Shore Outfalls Consolidation system, to the Islais Creek area. In Stage II, certain dry weather and wet weather facilities will be required, regardless of which Stage III alternative is chosen.

Channel Pump Station Modification and Wet Weather Force Main. In Stage II, the existing Channel Pump Station capacity will be increased from 114 mgd to 135 mgd, in conjunction with the operation of the North Point WPCP. In Stage III, the pump station's capacity would have to be increased to 233 mgd, while at the same time a wet weather force main would be constructed to the Islais Creek Transport/Storage Facility. The required wet weather transport facility (force main) alternatives differ mainly in their alignment--Alternative 21A would be in Indiana Street, while Alternative 21B would be in Tennessee Street. The final alternatives for the Channel-Islais Transport Facility and the Mariposa Transport/Storage Facility are presented in Table 2-1.

Alternatives 21A and 21B are both sized to transport 119 mgd from the Channel Pump Station to the Islais Creek Transport/Storage Facility, as required to reduce the level of overflows in the Channel basin to ten per year. Neither alternative will be required until Stage III.

Stage II Facilities. Stage II dry weather facilities consist of a flushing system for the existing South Side Channel Outfalls Consolidation facility between Fourth and Seventh Streets. Stage II wet weather facilities include the modifications to the Channel Pump Station described above and the Division Street connection. The Division Street connection links the Division Street sewer to the Channel Outfalls Consolidation facility. This connection will control overflows from the Division Street Overflow structure by diverting wet weather flow to the Channel Outfalls Consolidation facility.

## Mariposa Transport/Storage Facility

The four final alternatives originally identified after initial screening in the Interim Report were increased to eight in Chapter 3 in order to better evaluate Stage II requirements

Table 2-1 Final Alternatives for the Channel-Islais Transport Facility and Mariposa Transport/Storage Facility

| Alternative | Element | Description |
|---|---|---|
| 21A | Channel-Islais | Indiana Street force main |
| 21B | Channel-Islais | Tennessee Street force main |
| 24A[a] | Mariposa | Force main north on Third Street to Southside Outfalls Consolidation Channel. |
| 24B[a] | Mariposa | Force main south on Indiana Street to 21A or south on Tennessee Street to 21B. |
| 24F[a] | Mariposa | Force main south on Tennessee Street to existing Third Street sewer. |
| 24G[a] | Mariposa | Force main south on Illinois Street to existing Third Street sewer. |

[a]A postcharacter (namely 3 or 4) designates the location of the Mariposa wet weather pump station and storage.

3--indicates a pump station and reservoir at the southeast corner of Mariposa and Third Streets.

4--indicates a pump station and transport/storage box under the south end of China Basin Street.

(see Chapter 1, Clean Water Program Master Plan). The alternatives consist of combinations of storage in a reservoir near the existing Mariposa Pump Station or in a box storage structure under China Basin Street, and transport routes north to the Channel basin or south to the Islais Creek basin.

Alternatives 24A-3 and 24A-4. In these two alternatives, the wet weather flow from the Mariposa basin would be pumped north to the South Side Channel Outfalls Consolidation facility. Alternative 24A-3 involves storage in a covered reservoir, while Alternative 24A-4 involves storage in a box storage structure. Both alternatives will include a 5-mgd wet weather pump station.

Alternatives 24B-3A and 24B-3B. In these two alternatives, the wet weather flow from the Mariposa basin would be pumped south to the beginning of the gravity section of the Channel-Islais Transport Facility. In Alternative 24B-3A, this point is approximately 1,800 feet south in Indiana Street (Channel-Islais Transport Alternative 21A), while in Alternative 24B-3B, this point is approximately 2,300 feet south in Tennessee Street (Channel-Islais Transport Alternative 21B). In both alternatives, there would be a 5-mgd wet weather pump station and a 1.5-million-gallon covered reservoir located on a lot at the southeast corner of Mariposa and Third Streets.

Alternatives 24B-4A and 24B-4B. In these two alternatives, 1.5 million gallons of storage would be provided in a box structure under China Basin Street, and the wet weather flow from the Mariposa basin would be pumped south to either Alternative 21A or 21B as described above. The pump station is the same capacity but in a different location, resulting in force mains 400 feet longer than in Alternatives 24B-3A and 24B-3B.

Alternatives 24F-3 and 24F-4. These two alternatives are similar to Alternatives 24A-3 and 24A-4 in their pump station and storage aspects, but the wet weather flow would be pumped south in a force main located in Tennessee Street to the existing Third Street sewer at Twenty-third Street.

Alternative 24G-3. For this alternative, the pump station and reservoir are the same as Alternative 24F-3. The force main, which is located in Illinois Street, transports wet weather flow south to the existing Third Street sewer. This alternative was developed subsequent to the analysis of final alternatives and is described in the Recommended Best Alternatives section of this chapter.

## SUMMARY COMPARISON OF ALTERNATIVES

After the final alternatives are analyzed in Chapter 3, a comparison is made in Chapter 4 of cost and environmental and socioeconomic factors. This comparison results in a recommendation of the apparent best alternatives for the North Shore and Channel-Islais Transport Facilities and for the Mariposa Transport/ Storage Facility.

Evaluation Procedure

The evaluation procedure used to compare the final alternatives consists of ranking each alternative against a set of evaluation factors. These factors consist of cost, energy consumption, land requirements, traffic impacts, flexibility, reliability, implementability, and public acceptability. The importance of each factor was considered, and a comparison was made of a series of trade-offs between the advantages and disadvantages of each alternative against other alternatives.

A no project alternative was also considered, as required by state guidelines for planning wastewater facilities. This alternative was rejected primarily because it would result in a violation of the NPDES permit requirement calling for a reduction of overflows.

North Shore Transport Facility

The evaluation procedure detailed in Chapter 4 resulted in Alternative 31A being recommended as the apparent best alternative. It offers significant advantages in implementability and long-term flexibility. Although its present worth cost is almost 25 percent higher than Alternative 33, it is believed that potential legal problems with Alternative 33 (violation of NPDES requirements) effectively remove it from consideration. Alternative 32 is functionally similar to Alternative 31A. However, its present worth is 29 percent higher than Alternative 31A due to the difficult construction conditions along the bay side of the seawall.

Channel-Islais Transport Facility and
Mariposa Transport/Storage Facility

These two elements were evaluated together in this section in order to ensure physically compatible facilities. Combining Channel-Islais with Mariposa results in 12 possible master alternatives, as shown in Table 2-2, which were evaluated and ranked against the evaluation factors. This procedure resulted in Master Alternative 10 being recommended as the apparent best alternative. Alternative 10 consists of Channel-Islais Transport Facility Alternative 21B and Mariposa Transport/Storage Facility Alternative 24F-3. Subsequent to the analysis of final alternatives, the force main route 24G, located in Illinois Street, was developed.

## Table 2-2 Master Alternatives for the Channel-Islais Transport Facility and Transport/Storage Facility

| Master alternative | Channel-Islais component | | Mariposa component | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Force main | | Force main | | | | Pump station and reservoir | |
| | Indiana Street | Tennessee Street | Third Street north | Indiana Street | Tennessee Street | Illinois Street | Third and Mariposa | In China Basin Street |
| 1 | 21A | | 24A | | | | 3 | |
| 2 | 21A | | 24A | | | | | 4 |
| 3 | 21A | | | 24B | | | 3A | |
| 4 | 21A | | | 24B | | | | 4A |
| 5 | | 21B | 24A | | | | 3 | |
| 6 | | 21B | 24A | | | | | 4 |
| 7 | | 21B | | | 24B | | 3B | |
| 8 | | 21B | | | 24B | | | 4B |
| 9 | 21A | | | | 24F | | 3 | |
| 10 | | 21B | | | 24F | | 3 | |
| 11 | 21A | | | | 24F | | | 4 |
| 12 | | 21B | | | 24F | | | 4 |
| (a) | | 21B | | | | 24G[a] | 3 | |

[a]The force main route 24G located in Illinois Street was developed subsequent to the analysis of final alternatives in Chapter 4. For a description of this alternative, refer to the Recommended Best Alternative section of this chapter.

## RECOMMENDED APPARENT BEST ALTERNATIVES

The apparent best alternative for the North Bayside Project consists of transport facilities in the North Shore area; transport facilities and pump station modifications in the Channel-Islais area; and a pump station, reservoir, and transport facility in the Mariposa area. The apparent best alternative for each element is described in detail in Chapter 5.

### North Shore Transport Facility

The apparent best alternative for the North Shore Transport Facility is Alternative 31A. In Stage III, this facility will utilize the existing wet weather pumps at the North Shore Pump Station to pump up to 50 mgd of wet weather flow to the Channel basin.

Stage II Channel to North Shore Transport System. In Stage II, certain temporary facilities will be required to divert up to 45 mgd of wet weather flow to the North Point WPCP for primary treatment. This system will consist of static diversions (by gravity) of Channel basin wet weather flow into the existing North Point sewer, augmented by the controlled diversion of wet and dry weather flows into this sewer by two regulator stations and the existing Fourth Street Pump Station. This diversion and conveyance of flow to the North Shore basin is required to assure an overflow control level of ten events per year in the Channel basin during Stage II.

Stage III North Shore Transport Facility. This facility will consist of a 48-inch-diameter force main, 8,100 feet long, which will mostly parallel the existing 36-inch dry weather force main. Approximately 4,200 feet of the North Shore Transport Facility will be installed inside the existing North Shore Outfalls Consolidation, as shown on Figure 5-1. The profile of the new force main will increase the potential for a surge problem in the new wet weather system, so some surge protection devices will need to be installed in the existing North Shore Pump Station for Stage III operations.

Recommendations. It is recommended that Alternative 31A be selected as the apparent best alternative for the North Shore Transport Facility for the Stage III construction program. In Stage II, it is recommended that the construction program include the Channel to North Shore Transport system as shown on Figure 5-2.

### Channel-Islais Transport Facility

The apparent best alternative for the Channel-Islais Transport Facility is Alternative 21B. Features of this alternative are shown on Figure 5-5. Separate transport and pump station modifications are required at Stage II and Stage III.

Stage II Channel Pump Station Modifications. In Stage II, the required wet weather transport from the Channel basin to the Southeast WPCP via the existing 66-inch-diameter Indiana force main is 135 mgd. In order to deliver this flow, one additional pump will be added to the four existing pumps, and certain alterations will be made to the Channel Pump Station influent channel.

Stage II Division Street Connection. In order to control overflows from the Division Street overflow structure to China basin during Stage II operation, a new connection must be constructed between the Division Street sewer and the North Side Channel Outfalls Consolidation structure near the Channel Pump Station. This connection will also provide some additional storage for the Channel basin.

Stage II South Side Channel Outfalls Consolidation Flushing Line. This line is required in Stage II to provide adequate flushing water to keep flow velocities over 2 feet per second in the South Side Channel Outfalls Consolidation facility between Fourth and Seventh Streets. This velocity will ensure that solids do not accumulate and cause odor and maintenance problems.

Stage III Channel-Islais Transport Facility. The apparent best alternative, Alternative 21B, consists of a new 66-inch-diameter force main in Tennessee Street that will convey up to 119 mgd of wet weather flow from the Channel Pump Station to the Islais Creek Transport Facility on Twenty-sixth Street. Although strong opposition to construction in Tennessee Street was expressed by the local community, the traffic and construction advantages of this route exceed those of the alternative route along Indiana Street. In addition, an earlier alternative route in Illinois Street was reconsidered but rejected due to the severe space limitations in the street. Details are shown on Figure 5-5.

Stage III Channel Pump Station Modifications. In Stage III, in order to pump the required 233 mgd to Islais (114 mgd via the existing Indiana line plus 119 mgd in the new Tennessee line), a sixth pump will be added to the existing wet weather pumps in the Channel Pump Station. Refer to Figure 5-6 for details.

Recommendations. It is recommended that Alternative 21B be selected as the apparent best alternative for the Channel-Islais Transport Facility for the Stage III Construction program. In Stage II, it is recommended that the construction program include the Division Street connection, the Channel Pump Station modifications, and the South Side Channel Outfalls Consolidation flushing line.

## Mariposa Transport/Storage Facility

Alternative 24F-3 was selected in Chapter 4 as the apparent best alternative for Mariposa Transport/Storage Facility, as described above under the Summary Comparison of Alternatives. Subsequent to this selection, serious objections to construction in Tennessee Street were expressed by the local community in public meetings. Since the force main route for Alternative 24F-3 traverses Tennessee Street, a new alternative labeled 24G-3 was developed wherein the force main element of the Mariposa Transport/Storage Facility is routed down Illinois Street instead of Tennessee. Details are shown on Figure 5-11.

All Alternative 24G-3 facilities will be constructed in Stage II. These facilities will convey 5 mgd of wet weather flow from a new Mariposa wet weather pump station to the Islais Creek Consolidation sewer via the existing Third Street sewer. Wet weather storage is provided by a new 1.5-million-gallon covered reservoir at the new Mariposa wet weather pump station and a 60,000-gallon transport/storage facility adjacent to the existing Twentieth Street Pump Station. The two existing Mariposa basin pump stations will be retained and used for dry weather operations.

Recommendations. It is recommended that Alternative 24G-3 be selected as the apparent best alternative for the Mariposa Transport/ Storage Facility, and that it be included in the Stage II construction program.

APPENDIX B


# HYDROCONSULT ENGINEERS

**Hydrology/Hydraulics & Water Resources Planning Consultants**

**2079 Morello Avenue**
**Pleasant Hill, CA 94523**
**Phone (415) 671-2431**


**M E M O R A N D U M**

December 14, 1987

TO: H. Coffee/M. Wong

FROM: C. Phanartzis

SUBJECT: Mariposa Facilities
Additional Store/Pump Combinations

The total area of the Mariposa watershed is 271 acres, including 50.7 acres in the 20th Street sub-watershed. Storage/pumping scenarios for the 20th Street subarea were analysed separately and the results were submitted to you via memo of December 3, 1987. Since the pumped flow from the proposed 20th Street system will be discharged outside the Mariposa watershed boundaries, the remaining area, 220.3 acres, was also analysed separately for the 10 overflows per year requirement. The results are shown below.

| Pumping Rate (MGD) | Gross Storage Required (MG) |
|---|---|
| 5 | 1.55 |
| 6 | 1.30 |
| 7 | 1.10 |
| 8 | 0.95 |
| 9 | 0.80 |
| 10 | 0.70 |

The storage volumes shown above may be further refined by subtracting usable storage in the existing sewers and adding storage volume needed for start/stop of pumps (check with mechanical).

cc: T. Landers
J. O'Brien
R. Swanstrom
S. Young

CP/ss

# HYDROCONSULT ENGINEERS

**Hydrology/Hydraulics & Water Resources Planning Consultants**

2079 Morello Avenue
Pleasant Hill, CA 94523
Phone (415) 671-2431


December 3, 1987

## MEMORANDUM

TO: Harold C. Coffee
Manfred Wong

FROM: Chris Phanartzis

SUBJECT: Mariposa Facilities - 20th Street
Subarea Store/Pump Scenario

The 20th Street subarea was revised by Suzanne Young to 50.7 acres, based on a recent field investigation and an existing study that came to light a couple of weeks ago. The area in question is almost entirely paved. Hence, a runoff coefficient of 0.9 seems appropriate.

A quick analysis of various storage/pumping combinations resulted in the following alternative facility sizes, all of which meet the 10 overflows per year criterion.

| Alternative No. | Pumping Rate (MGD) | Storage (MG) |
|---|---|---|
| 1 | 1 | 0.5 |
| 2 | 2 | 0.3 |
| 3 | 3 | 0.175 |

If the pumped flow is discharged outside the Mariposa watershed, then the Mariposa facility sizes must be revised downwards.

Gravity alternatives for the 20th Street subarea will be evaluated next.

cc: R. E. Badgley
T. F. Landers
J. O'Brien
R. D. Swanstrom
S. Young

CP/ec

.875
.125

APPENDIX C

DeLEUW CATHER

De Leuw, Cather & Company
Engineers and Planners • San Francisco

FINAL REPORT

MARIPOSA FACILITIES TRAFFIC STUDY

De Leuw-Greeley-Hyman

120 Howard Street
San Francisco, CA 94105

19 February 1988

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## OVERVIEW OF THE STUDY AREA

### LOCATION AND LAND USE

The proposed Mariposa transport/storage facilites would be located in the southern part of a heavily industrialized area of the City known as the Central Basin. The Central Basin is bounded by Mission and Islais Creeks on the north and south and by the San Francisco Bay and I-280 on the east and west. The streets and intersections potentially affected by the project alternatives are included in the area extending from Mariposa Street southerly to Army Street and are indicated on Figure 1. Land uses in this area include a mix of heavy and light industrial, boat marina operations, and multi-family housing. The heavier industrial activities include materials warehousing and ship repair.

### STREET NETWORK

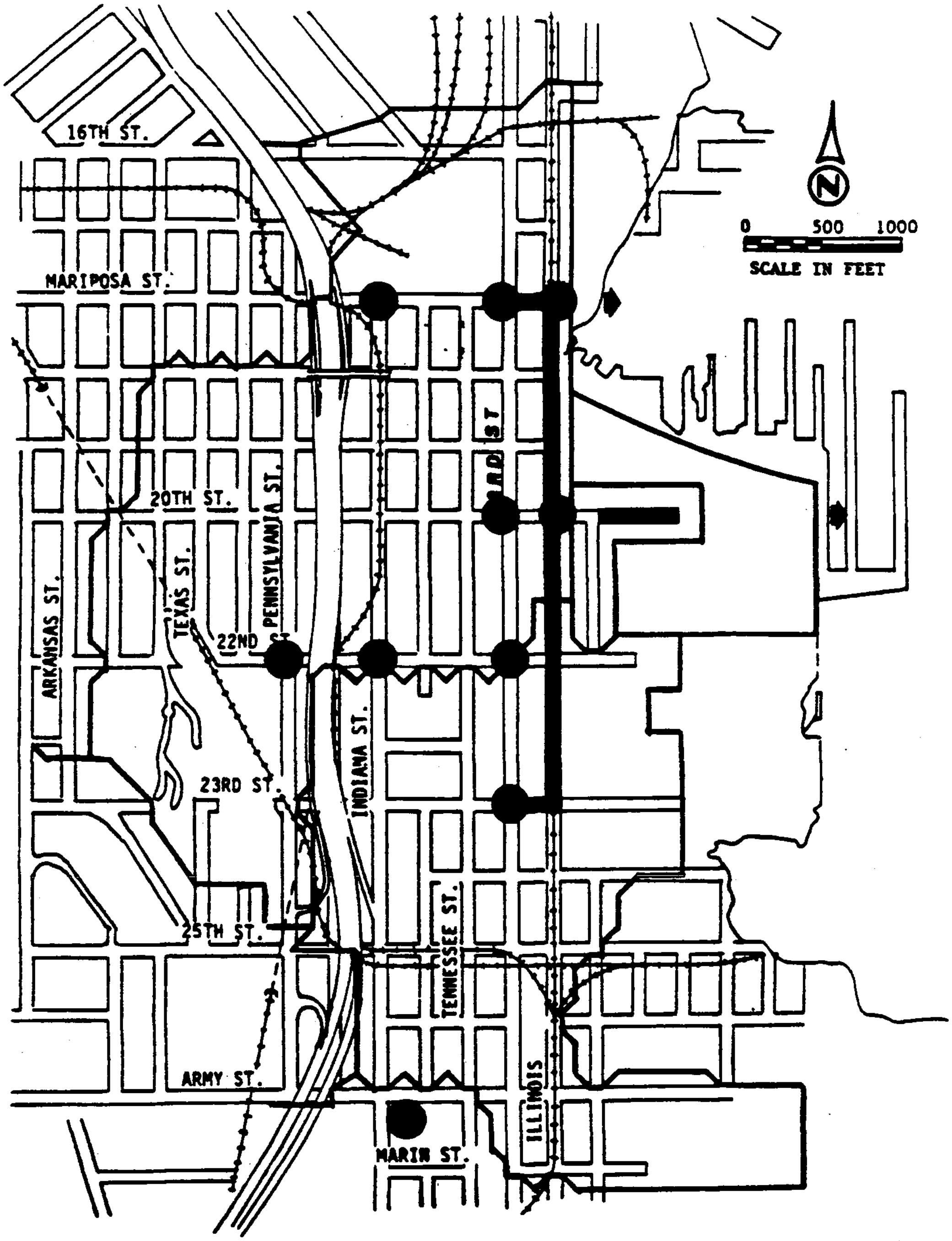
The street network in this area forms a conventional grid pattern. However, through traffic routes are sparse because of the barriers created by the navigable creeks, the the San Francisco Bay to the east, and State Route (SR) 101 and hilly topography to the west. Although there is access to and from I-280 in this area, the only north-south surface arterial is Third Street, a divided four-lane street with parking along both curbs. East-west through traffic is confined to Army Street and 16th Street, both of which are four-lane two-way streets with parking at the curbs.

Local streets that may be affected by the proposed project, east of Third Steet, include Mariposa Street, 20th Street, 22nd Street, 23rd Street and Illinois Street. All are two-lane, two-way streets with parking at the curbs. Illinois Street has a double railroad track (Santa Fe) down the middle.

Local streets that may be affected by the proposed project, west of Third Street, include Mariposa Street, 22nd Street, 23rd Street, Pennsylvania Street, and Indiana Street. Mariposa Street is a three lane (two lanes westbound), two-way street with parking along the south curb. The rest of the streets are two-lane, two-way streets, also with parking at the curbs.

### TRAFFIC PATTERNS

Peak-hour traffic patterns on the through routes in the area consist of an easterly and northerly inflow of traffic in the morning, followed by a westerly and southerly outflow in the afternoon. South of Mariposa Street, however, north/south PM volumes on Third Street can be approximately equal. The peak hours tend to be 7:30 to 8:30 AM and 4:30 to 5:30 PM. Because the predominant flows are north and south, volumes on Third Street are larger than on either Army Street or 16th Street.




**LEGEND**
**Construction Impact Areas**
Intersection
Street

**FIGURE 1**
**MARIPOSA TRAFFIC STUDY**

## MARIPOSA TRAFFIC STUDY AREA

Army Street is more heavily utilized than 16th Street. Westbound PM volumes along Mariposa Street are equal to volumes along Third Street.

Inspection of the area indicates some peak-hour congestion can occur at the intersections of both 16th and Army Streets with Third Street, resulting primarily from left turn movements. However, intervening intersections along Third Street appear to operate without significant delay during the peak hours. Reflecting the industrial uses in the area, trucks constitute about 10% of the peak-hour traffic on Third Street.

Traffic on the local streets listed above is generally light even during peak hours because most of the adjacent land uses generate relatively little traffic. On-street parking utilization on local streets east of Third and adjacent to Third Street is low to moderate except in the vicinity of the blocks bounded by Third and Illinois Streets between 18th and 25th Streets. The light cross traffic at the intersections of these local streets with Third Street is the primary factor in permitting congestion-free operation with Third Street.

Traffic on the local streets west of Third Street is also generally light during peak hours with the exception of Mariposa Street. Mariposa has heavier traffic flows particularly during the PM Peak because it accesses I-280. The presence of a northbound off-ramp and a southbound on-ramp to I-280 create significantly higher volumes on the western end of the street with substantial turning volumes to and from the downtown direction at Third Street. On-street parking utilization of these local streets is high because of the several businesses, including the MUNI Woods Facility, located in the immediate area.

Traffic and street capacities are considered in more detail following a description of the alternatives, which includes more information on the potentially affected street areas.

**TRANSIT SERVICE**

Transit service in the area includes:

o 15 Third Street, diesel coach operating through the area on Third Street approximately every five minutes in each direction during peak hours and up to every 10 minutes during daytime off peak periods. 24-hour service is provided.

o 22 Fillmore, electric trolley operating on the southbound side of Third Street between 18th and 20th Streets. Frequencies are six to eight minutes throughout most of the day with less frequent service late at night. 24-hour service is provided.

- 48 Quintara, diesel coach operating through the area on a clockwise circle of the rectangle formed by Third, Illinois, 20th, and 22nd Streets. Peak-period frequencies average around six minutes but off-peak frequencies are 15 to 20 minutes.

Of these services, the 22 Fillmore is most vulnerable to disruption because of its dependence on overhead electric wires. The 15 Third Street and the 22 Fillmore are both very heavily utilized, especially during peak periods.

## DESCRIPTION OF THE ALTERNATIVES

The current eight alternatives are depicted on Figures 2 through 8a. They include:

T-1A: A tunnel down Third Street, with junction boxes and entry shafts at Third and Mariposa, Illinois and Mariposa, Third and 20th, 20th and Michigan*, and southeast corner of Army and Indiana. In addition to affecting the intersections noted, the south side of Mariposa would be affected by construction east of Third Street to Illinois as would 20th Street from 20th and Michigan easterly to the existing 20th Street pumping station. The entry shaft at Army and Indiana Streets would be in the railroad easement outside the street right of way.

T-1B: A tunnel down Illinois to 22nd and from there down Third Street, with junction boxes at Illinois and Mariposa, Illinois and 20th, 20th and Michigan, Third and 22nd, southeast corner of Army and Indiana. In addition to affecting the intersections noted, 20th Street would be affected by construction from Michigan easterly to the existing pumping station.

T-1C: A tunnel down Illinois to 20nd and from there down Third Street, with junction boxes at Illinois and Mariposa, Illinois and 20th, 20th and Michigan, Third and 22nd, southeast corner of Army and Indiana. In addition to affecting the intersections noted, 20th Street would be affected by construction from Michigan easterly to the existing pumping station.

T-2A: A tunnel down Third Street with junction boxes at Illinois and Mariposa, Third and Mariposa, Third and 22nd, and southeast corner of Army and Indiana. In addition to affecting the intersections noted, the south side of Mariposa would be affected by construction east of Third Street to Illinois as would a short section of 20th Street from east of 20th and Michigan easterly to the existing pumping station.

T-2B: A tunnel down Illinois to 22nd and from there down Third Street, with junction boxes at Illinois and Mariposa, Third and 22nd, southeast corner of Army and Indiana. In addition to affecting the intersections noted, 20th Street would be affected by construction from east of Michigan to the existing pumping station.

T-3: A tunnel along Mariposa Street from Illinois to Indiana then south down Indiana to 22nd Street and turning west to Pennsylvania, then south along Pennsylvania to Army. Junction

*Although Michigan Street does not really go through to 20th Street, it is convenient to refer to it as if it did to denote an approximate location for an access shaft.

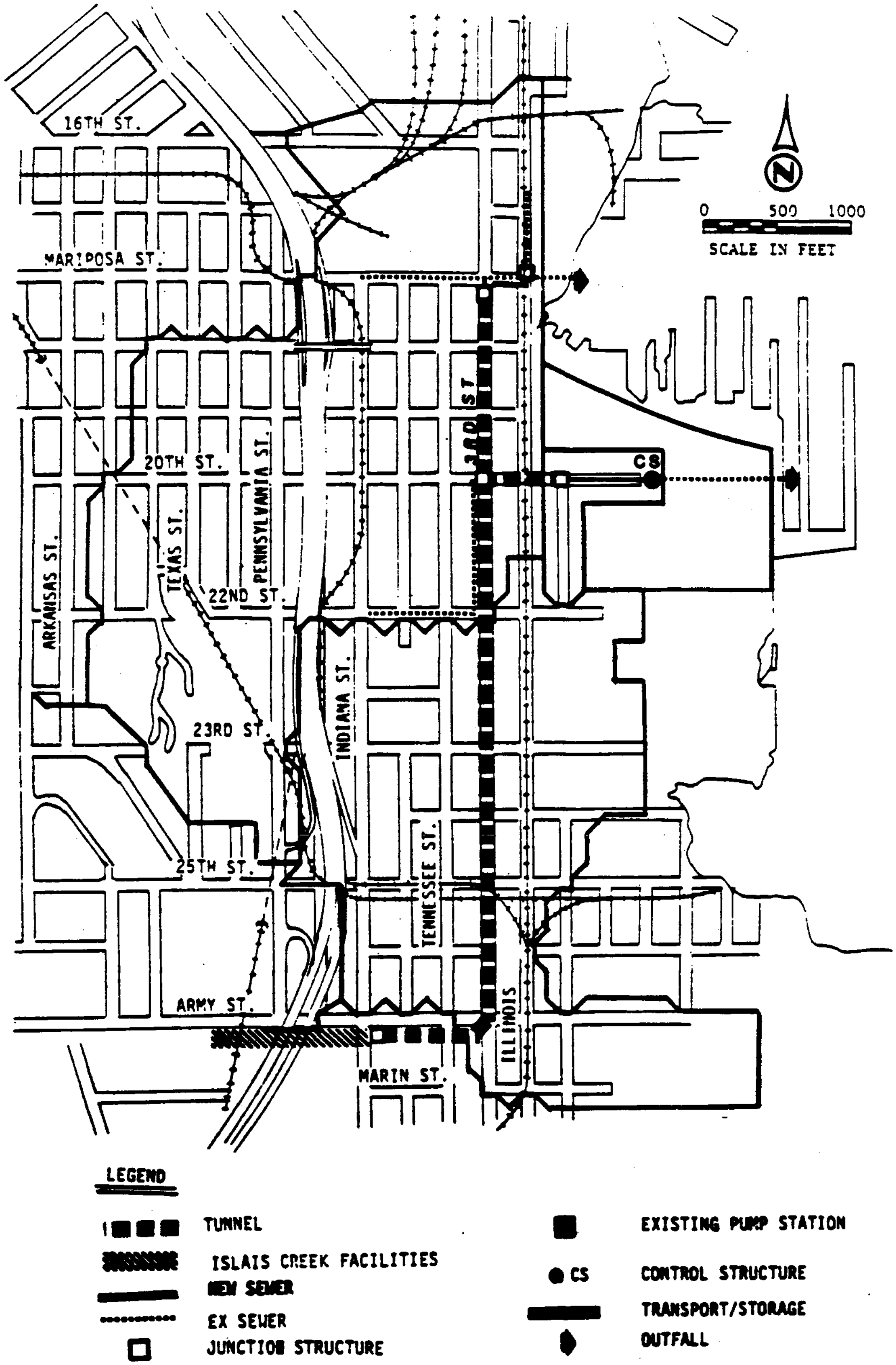
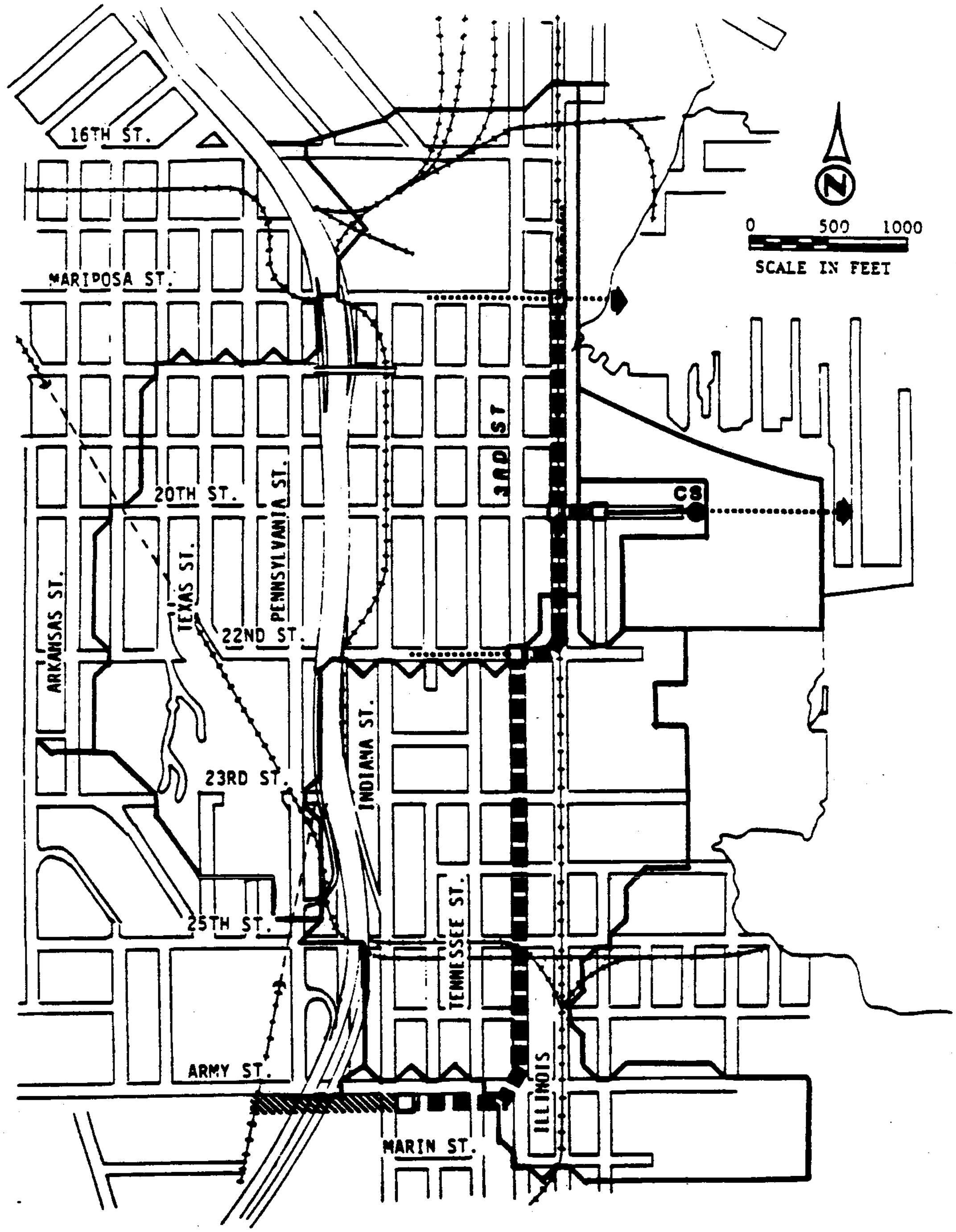



**FIGURE 2**
**MARIPOSA TRAFFIC STUDY**

## ALTERNATIVE T-1A




LEGEND

| | | | |
|---|---|---|---|
| | TUNNEL | | EXISTING PUMP STATION |
| | ISLAIS CREEK FACILITIES | ● CS | CONTROL STRUCTURE |
| | NEW SEWER | | TRANSPORT/STORAGE |
| | EX SEWER | | OUTFALL |
| | JUNCTION STRUCTURE | | |

**FIGURE 3**
**MARIPOSA TRAFFIC STUDY**

**ALTERNATIVE T-1B**

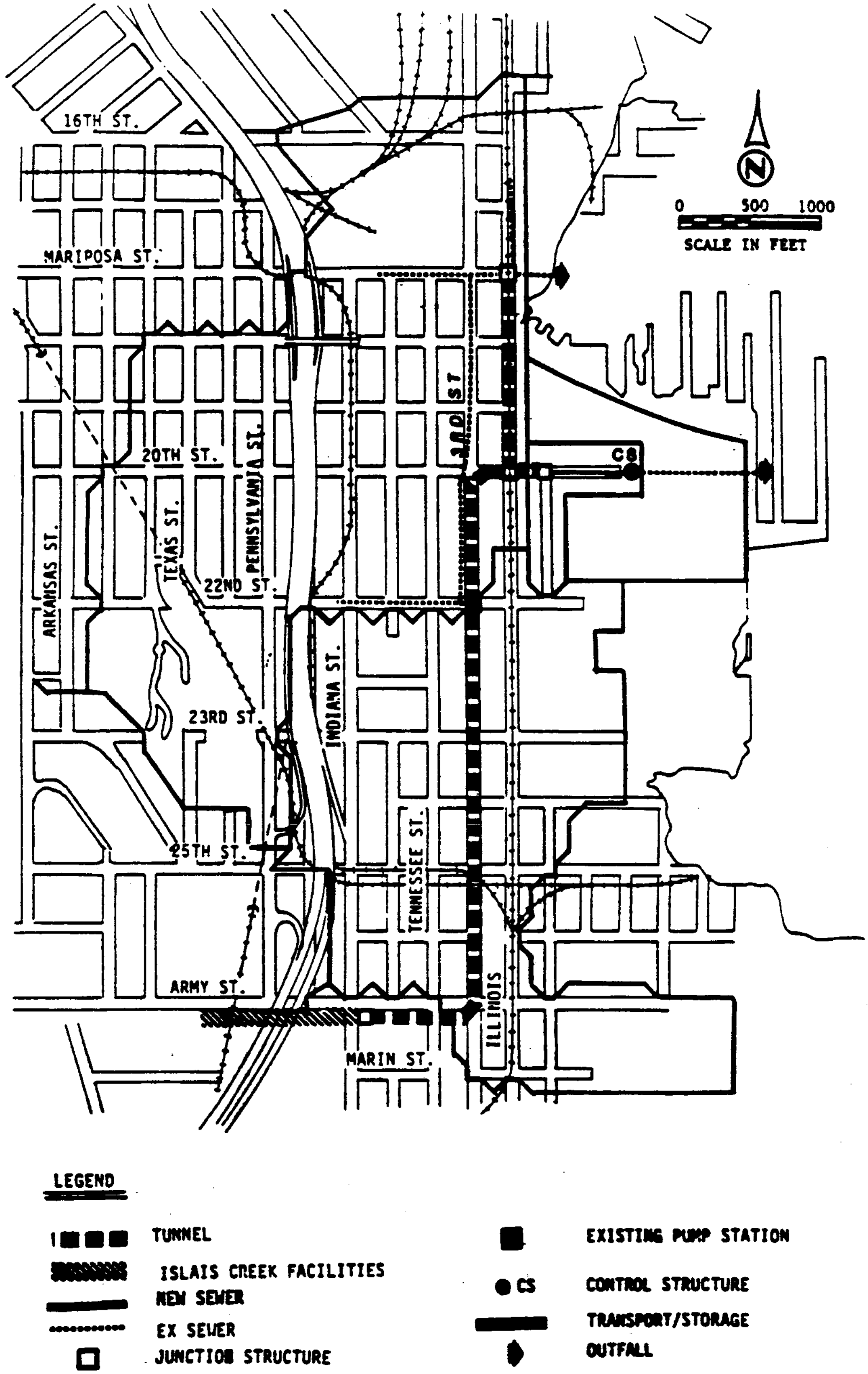



**FIGURE 4**
**MARIPOSA TRAFFIC STUDY**

**ALTERNATIVE T-1C**

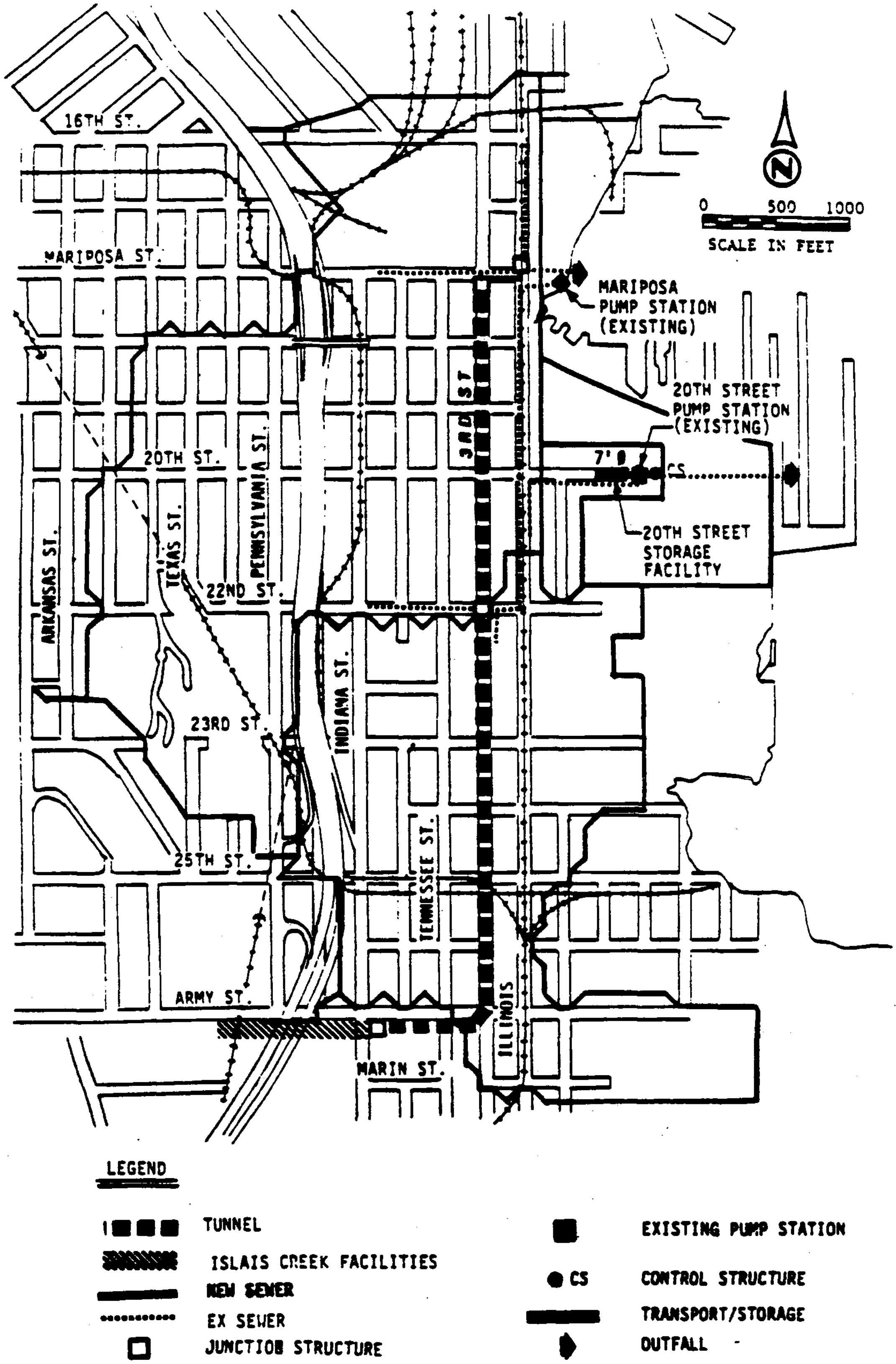



**FIGURE 5**
**MARIPOSA TRAFFIC STUDY**

**ALTERNATIVE T-2A**

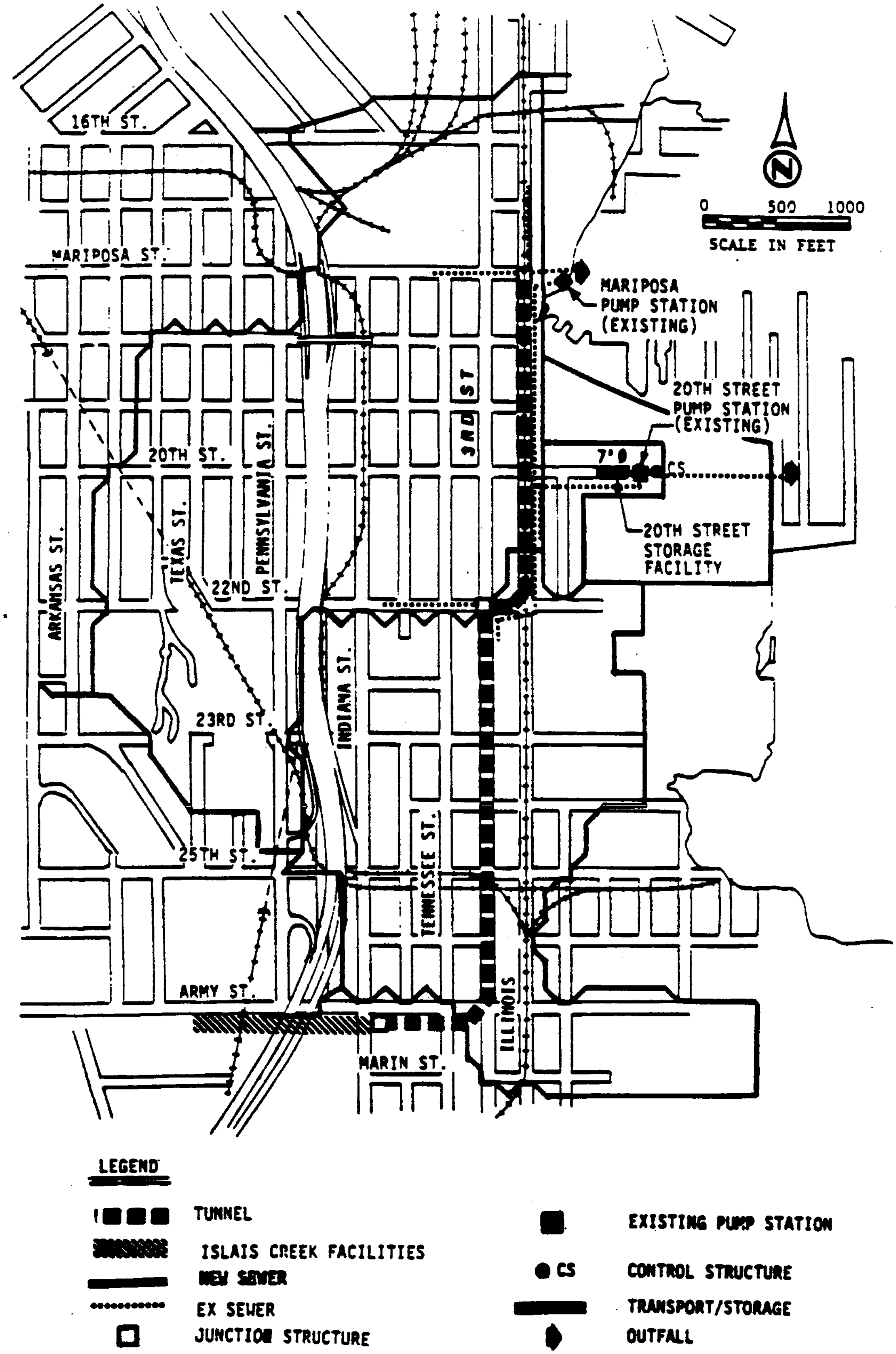



**FIGURE 6**
**MARIPOSA TRAFFIC STUDY**

**ALTERNATIVE T-2B**

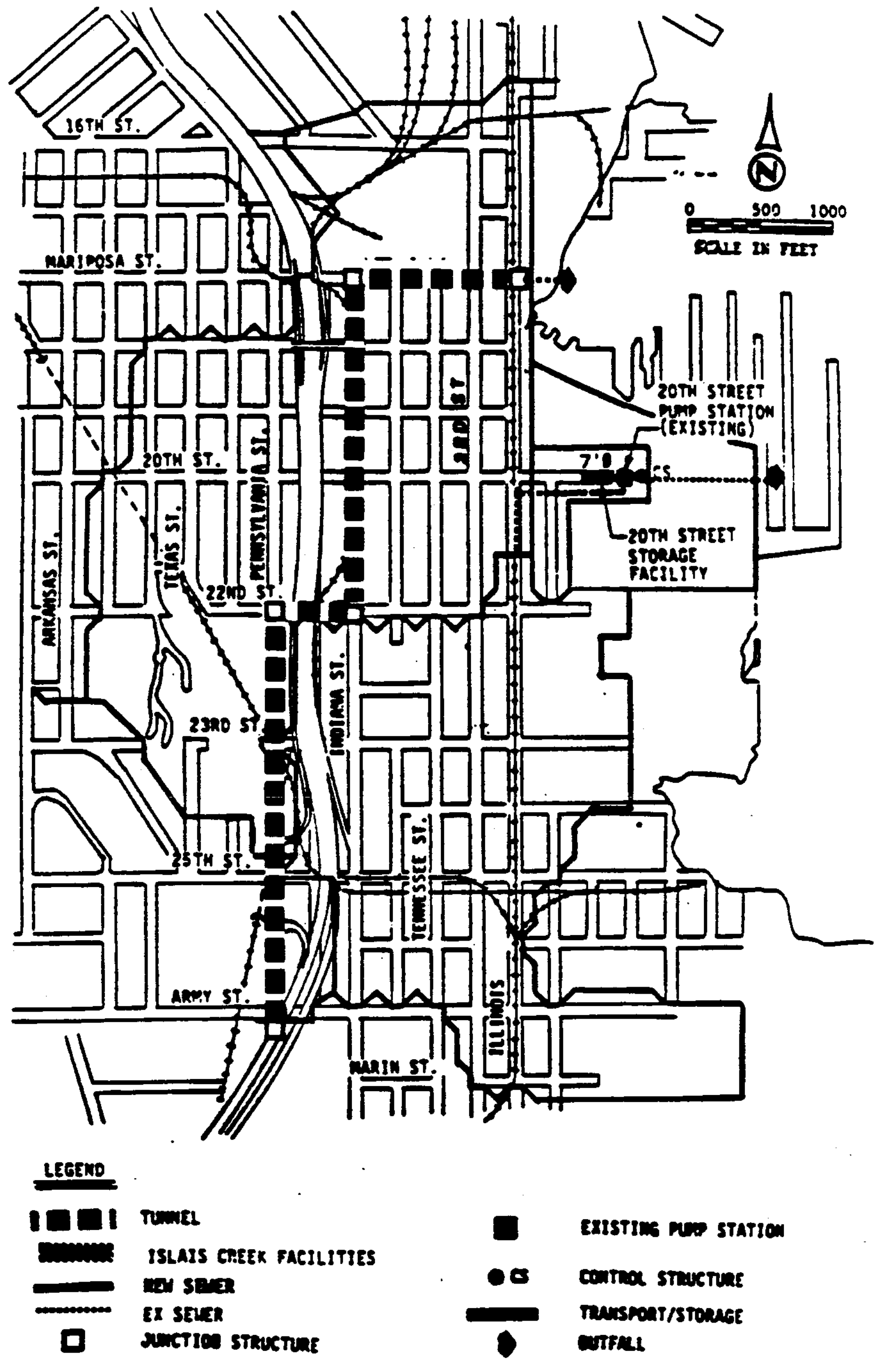



**FIGURE 7**
**MARIPOSA TRAFFIC STUDY**

**ALTERNATIVE T-3**

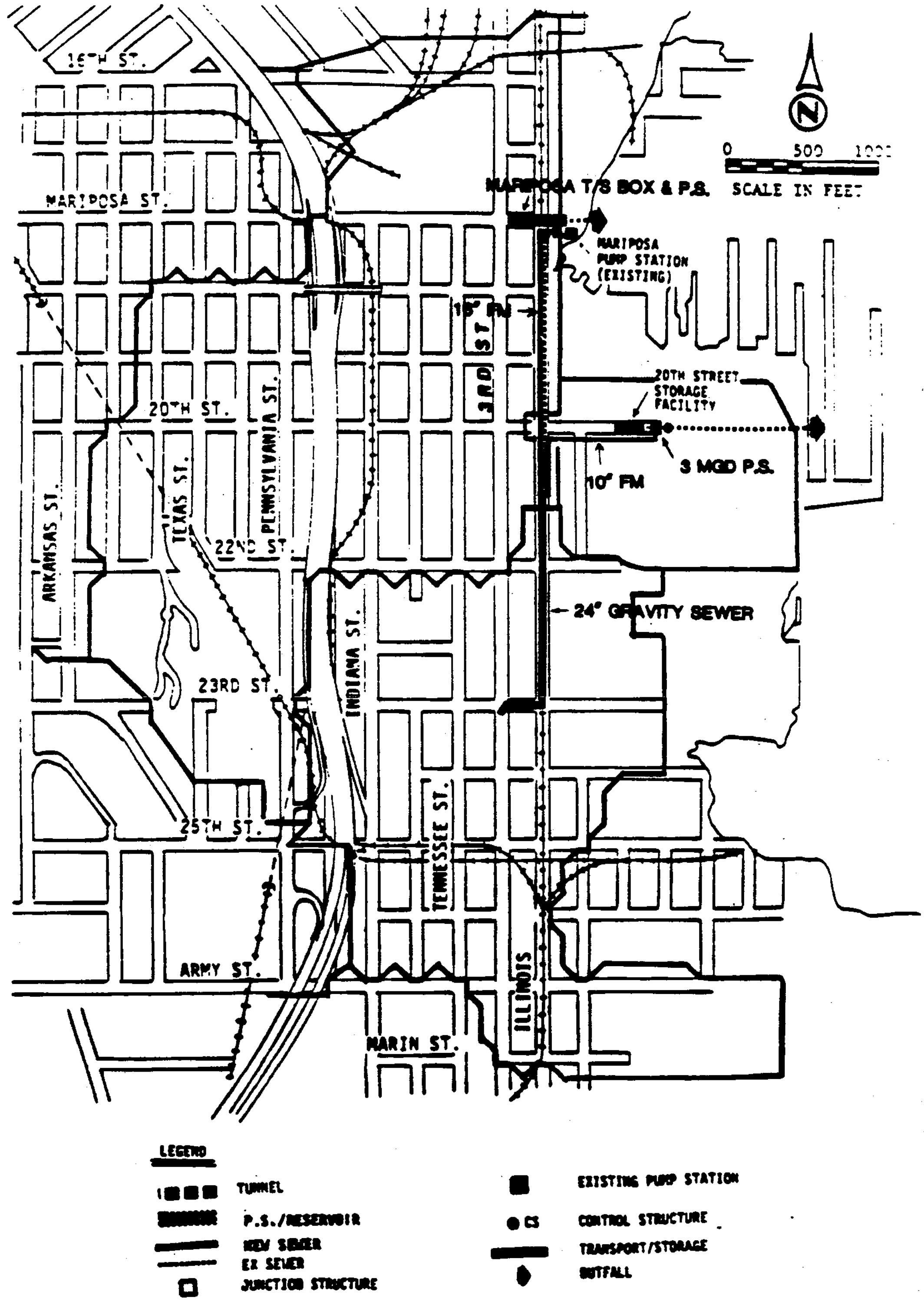



**FIGURE 8**
**MARIPOSA TRAFFIC STUDY**

**MARIPOSA T/S PUMPING ALTERNATIVE**

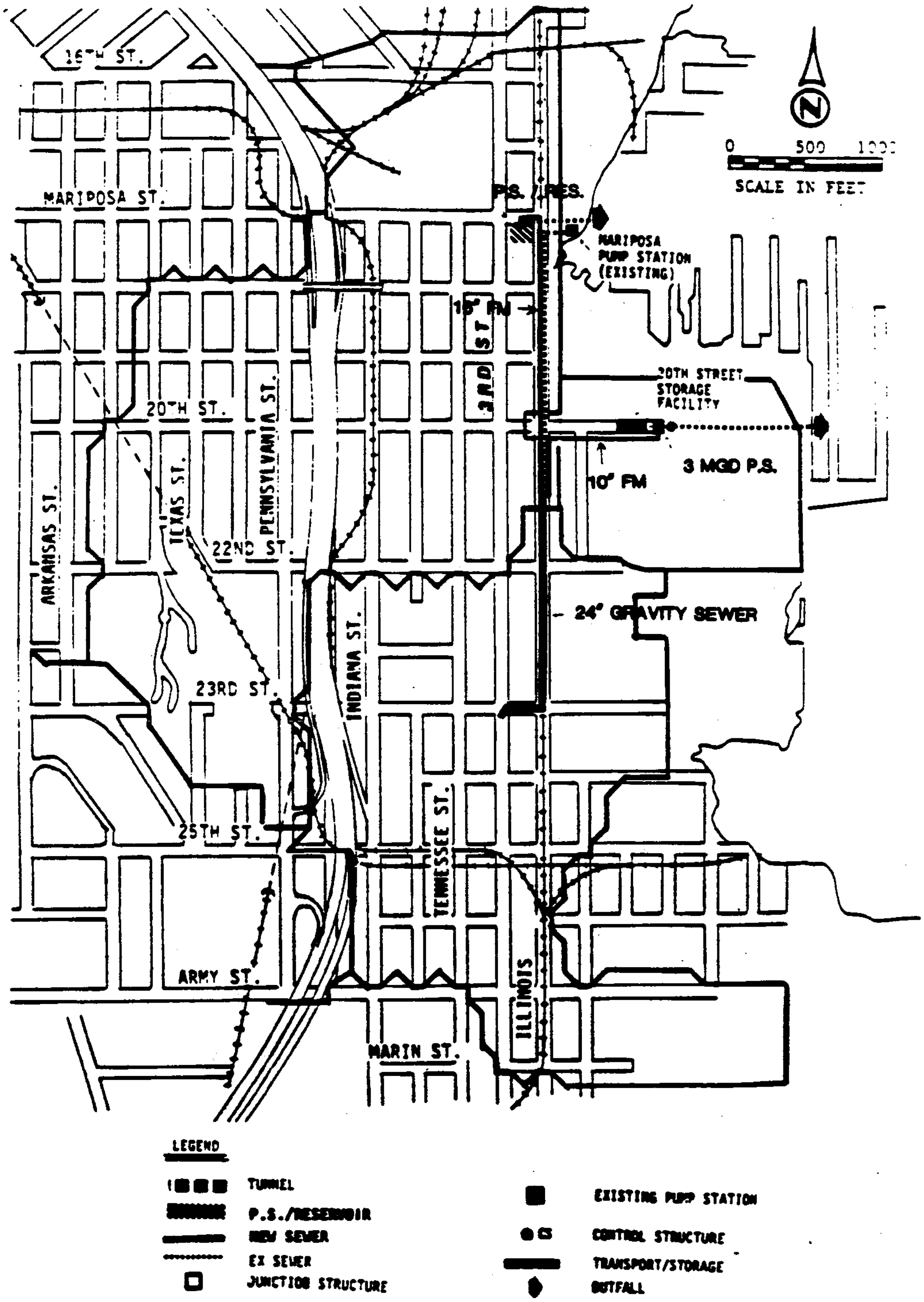



**FIGURE 8A**
**MARIPOSA TRAFFIC STUDY**

**P.S./RESERVOIR ALTERNATIVE**

boxes would be located at Mariposa and Illinois, Mariposa and Indiana, 22nd and Indiana, 22nd and Pennsylvania, and in the railroad right-of-way south of Pennsylvania and Army. In addition to affecting the intersections noted, Mariposa, Illinois, Indiana, Pennsylvania Street, and 20th Street from Michigan easterly to the existing pump station would be affected by construction of the sewer system.

T/S: This alternative proposes construction of a Transport/Storage Box approximately 360 feet long, 22 feet wide, and 22 feet deep on Mariposa Street between Third Street and the existing Mariposa Pump Station for the purpose of collecting wet weather flows. A new wet-weather pumping station would be constructed inside the box. The existing pump station would be refitted with new pumps and electrical controls to handle dry-weather flows.

Wet weather flow would be pumped through a new 16-inch force main on Illinois Street, then intercepted by a new 24-inch gravity sewer at 21st Street. This 24-inch sewer would continue along Illinois and connect to an existing 3-foot by 4.5 foot sewer at 23rd and Third Street. Dry weather flow would be pumped through the existing 10-inch Mariposa force main on Illinois Street to the proposed 24-inch sewer at 21st Street. In addition to the intersections and streets noted, 20th Street would also be affected by construction from Illinois to the existing pump station. Based on cost and engineering considerations, this is the alternative most likely to be selected.

PS/Reservoir:

This alternative is identical to the T/S Alternative except that the storage box and pump station would be constructed on a privately owned lot located at the southwest corner of Mariposa and Illinois Streets. New sewer pipes connecting existing sewers to the reservoir/pump station would be planned in Mariposa Street between Illinois and Third Streets.

To summarize, the affected streets include:

1. Mariposa Street from Third to Illinois.

2. 20th Street from Illinois Street easterly to existing 20th Street Pumping Station more or less at end of street.

3. Illinois Street between Mariposa and 23rd Street.

4. 23rd Street between Third and Illinois.

The affected intersections include:

1. Third and Mariposa.
2. Indiana and Mariposa.
3. Third and 20th.
4. Third and 22nd.
5. Indiana and 22nd.
6. Pennsylvania and 22nd.
7. Illinois and Mariposa.
8. Illinois and 20th.
9. Army and Indiana (southeast corner only--traffic way not affected).
10. Third and 23rd.

With the exception of the T/S Alternative, interuptions to traffic should be minimal from the Mariposa project. Only sections of minor streets and part of the 23rd/Third Street intersection are actually excavated. For the Third Street Alternatives, however, up to three shafts within Third Street would be required for junction boxes and access to the tunnel. The placement of these shafts will be quite critical with respect to disruption of traffic on Third Street. Likewise, the excavation at 23rd/Third would have to be performed at night.

The placement of a shaft in Mariposa Street for the T-3 Alternative may require closing the eastbound lane of the street for the construction period, causing rerouting of I-280 traffic.

## TRAFFIC COUNTS

### EXISTING DATA

Relatively few traffic counts were available from the City of San Francisco for this study area. Existing mechanical counts included:

- o 16th Street west of Third Street (6/86)--8,090 veh/day.
- o Mariposa Street east of Minnesota Street (7/86)--10,060 veh/day.
- o Third Street north of Army Street (6/85)--25,580 veh/day, (14,360 NB, 11,220 SB).

Existing turning movement counts included:

- o Third/25th (3/87).
- o Third/Army (11/85 and 1986).

Appendix A includes the count sheets obtained from the City.

### CURRENT TRAFFIC COUNTS

Turning Movement Counts

Traffic counts were conducted at nine affected intersections in October 1987 and January 1988. Traffic volumes were estimated for the Indiana and 22nd Street intersection based on counts along Indiana and at 22nd and Pennsylvania. Because the above 24-hour mechanical counts indicate the variation of traffic throughout the day, only turning movement counts were necessary at the affected intersections to supplement these data. The most important intersections were counted during the AM and PM peak periods. Unsignalized intersections included Army/Indiana, Mariposa/Indiana, Pennsylvania/22nd, and Indiana/22nd. Appendix A contains the traffic counts.

Figures 9 through 18 summarize turning movements at important intersections within the study area. These intersections include the nine potentially affected intersections listed above (Indiana/22nd was not included because volumes were estimated) plus the intersection of Army and Third Streets. The Army/Third intersection was included because it is the most congested intersection in the study area and could be affected by haul traffic. Turning movement data was also available from the City (1986).

The turning movement counts indicate a strong north/south through movement at all Third Street intersections with only Army Street and Mariposa Street having significant turning movements. The predominant flow at Army and Indiana Streets is east/west with significant turning movements to the north. Because of the large turning movements to and

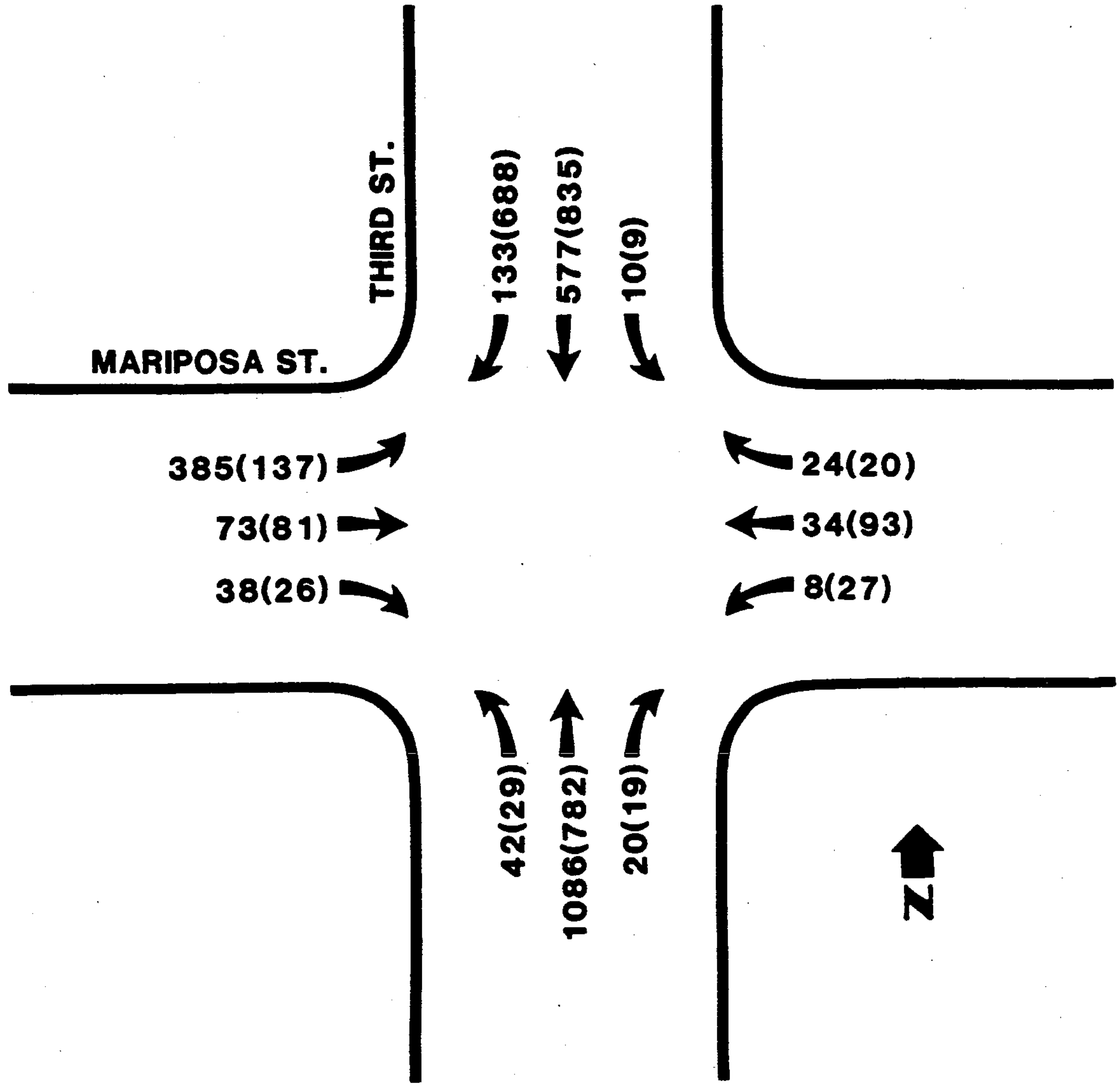



FIGURE 9
MARIPOSA TRAFFIC STUDY

AM(PM) PEAK PERIOD TRAFFIC VOLUMES
THIRD AND MARIPOSA
10/87

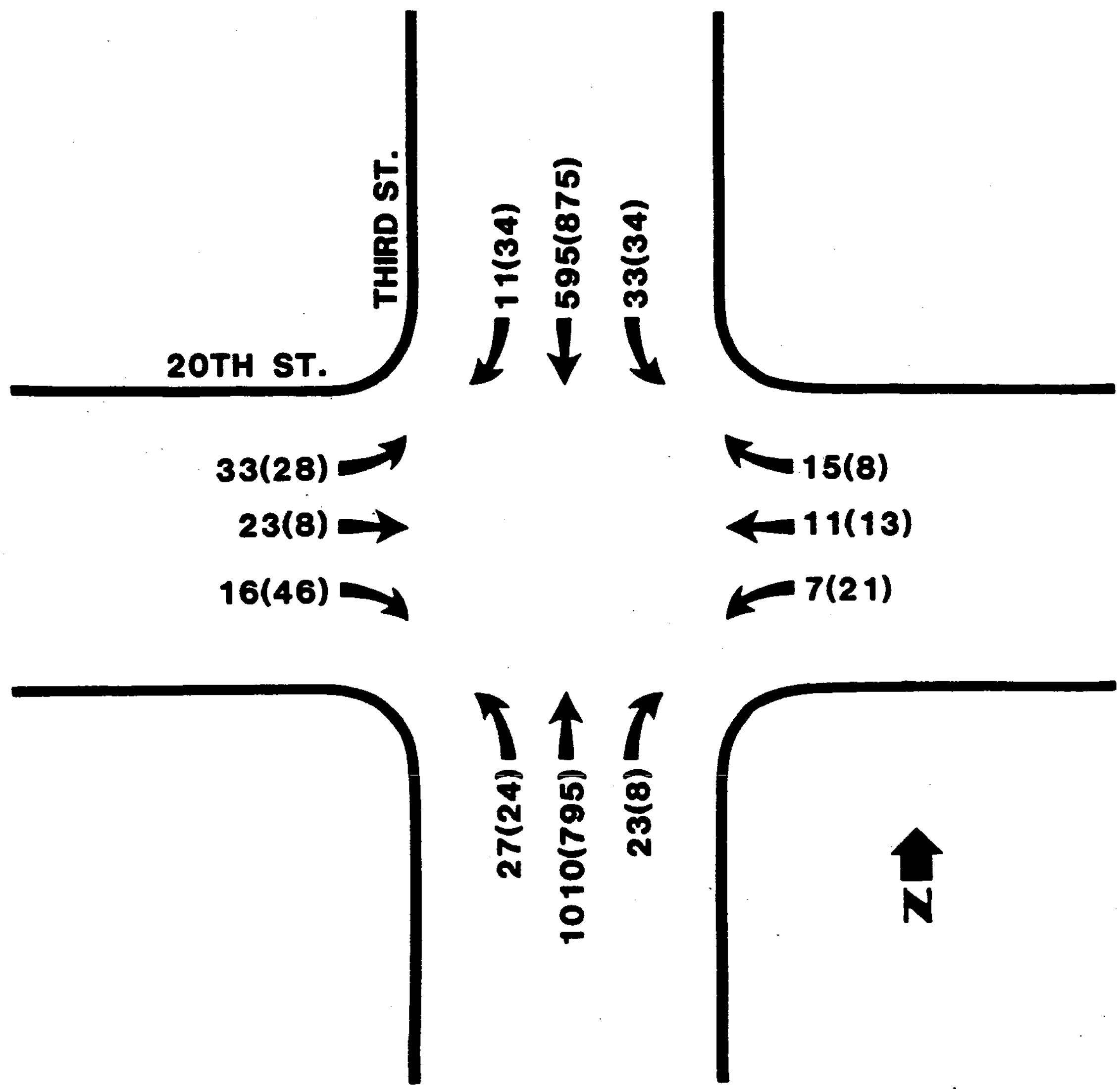



FIGURE 10
MARIPOSA TRAFFIC STUDY

AM(PM) PEAK PERIOD TRAFFIC VOLUMES
THIRD AND 20TH
10/87

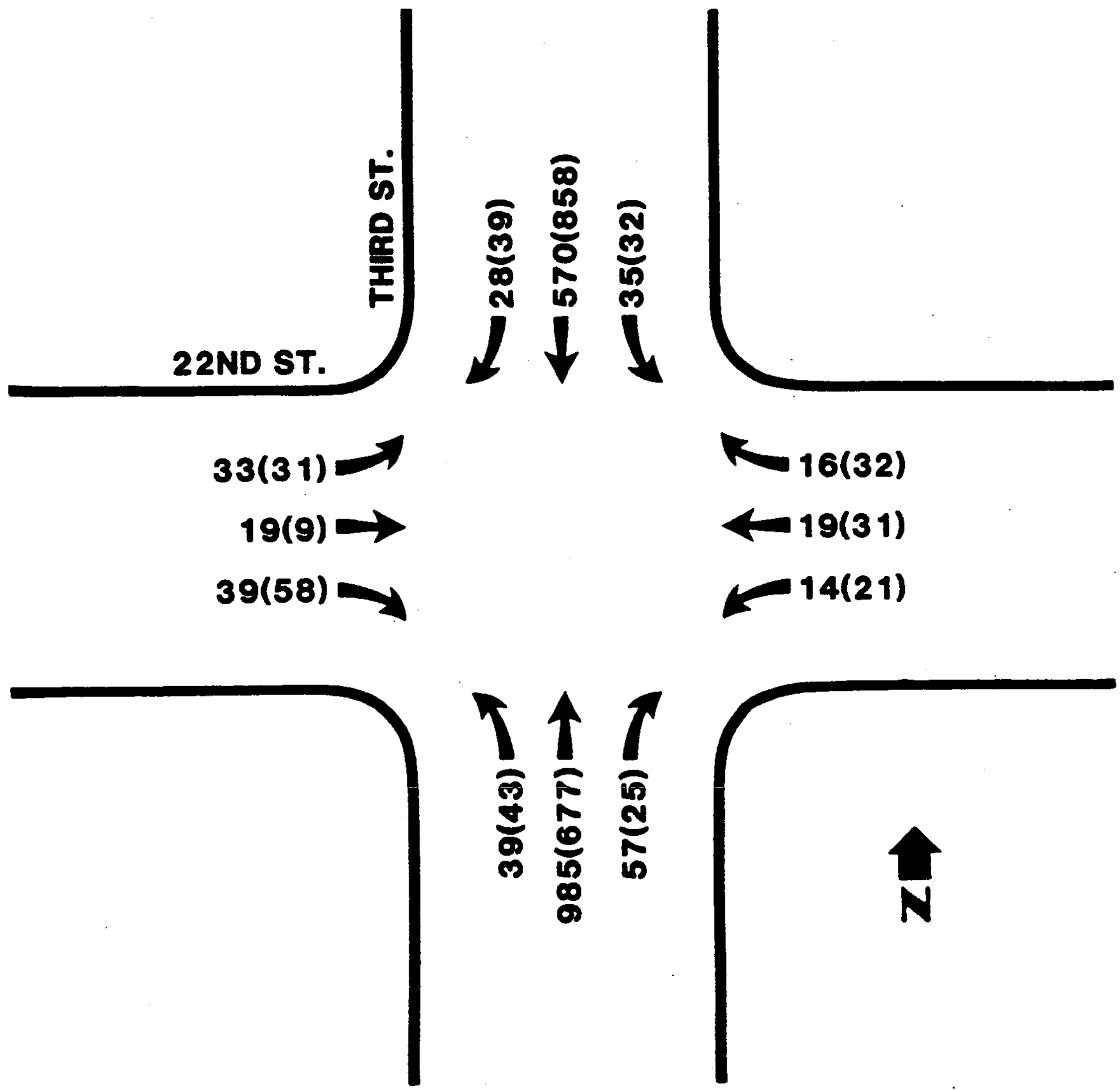



**FIGURE 11**
**MARIPOSA TRAFFIC STUDY**

**AM(PM) PEAK PERIOD TRAFFIC VOLUMES**
**THIRD AND 22ND**
**10/87**

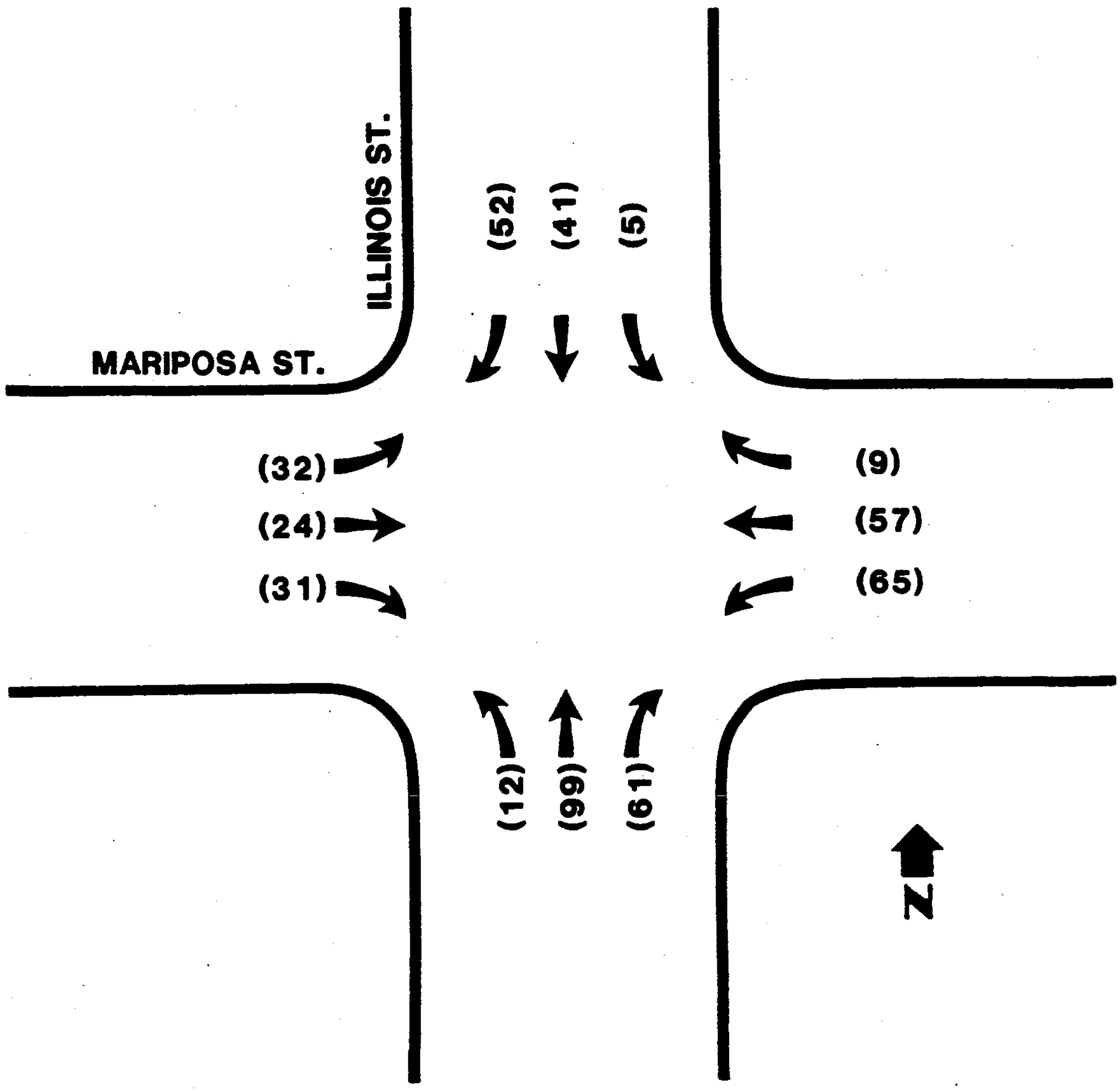



FIGURE 12
MARIPOSA TRAFFIC STUDY

AM(PM) PEAK PERIOD TRAFFIC VOLUMES
ILLINOIS AND MARIPOSA
10/87

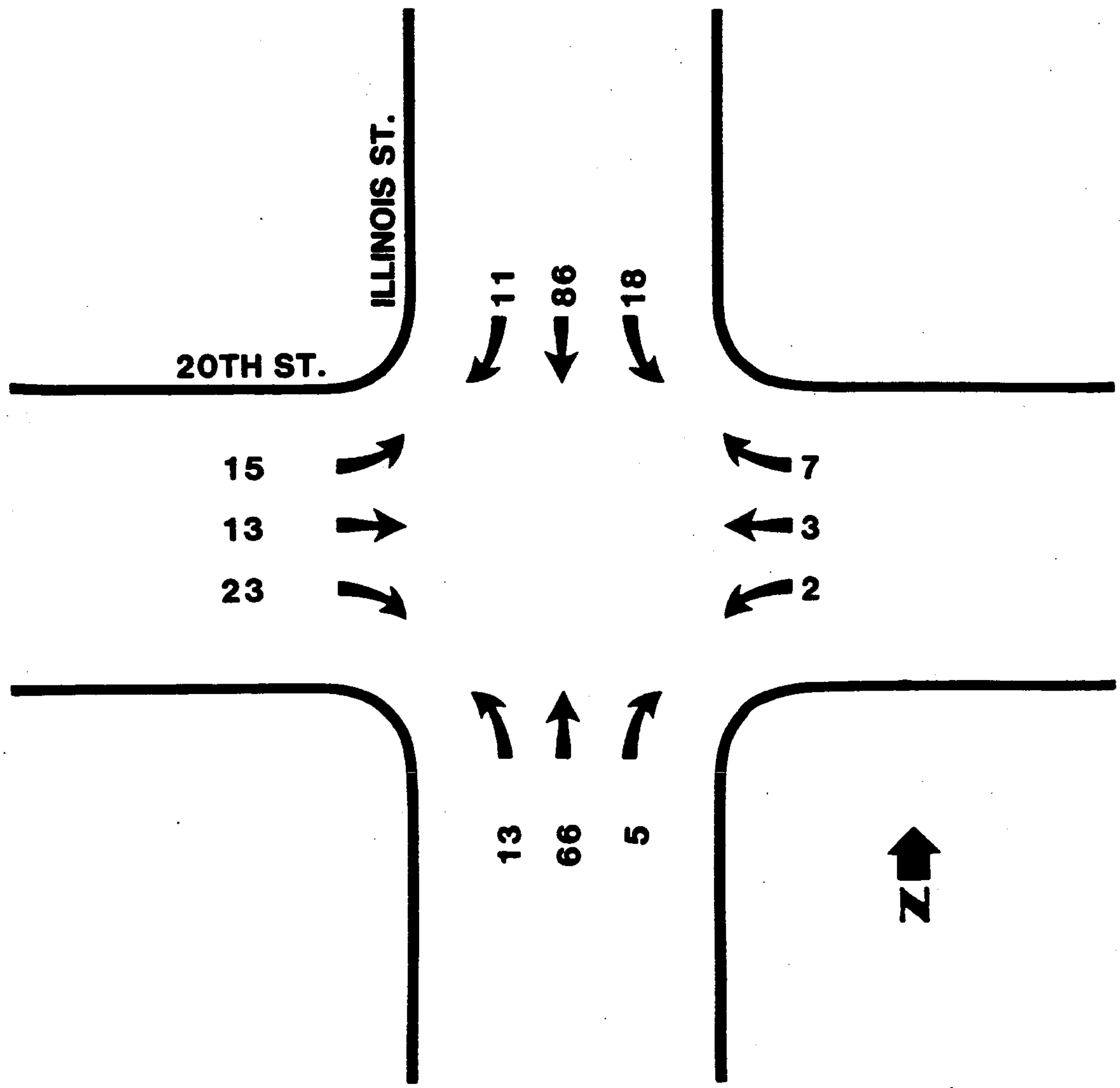



FIGURE 13
MARIPOSA TRAFFIC STUDY

AM(PM) PEAK PERIOD TRAFFIC VOLUMES
20TH AND ILLINOIS
10/87

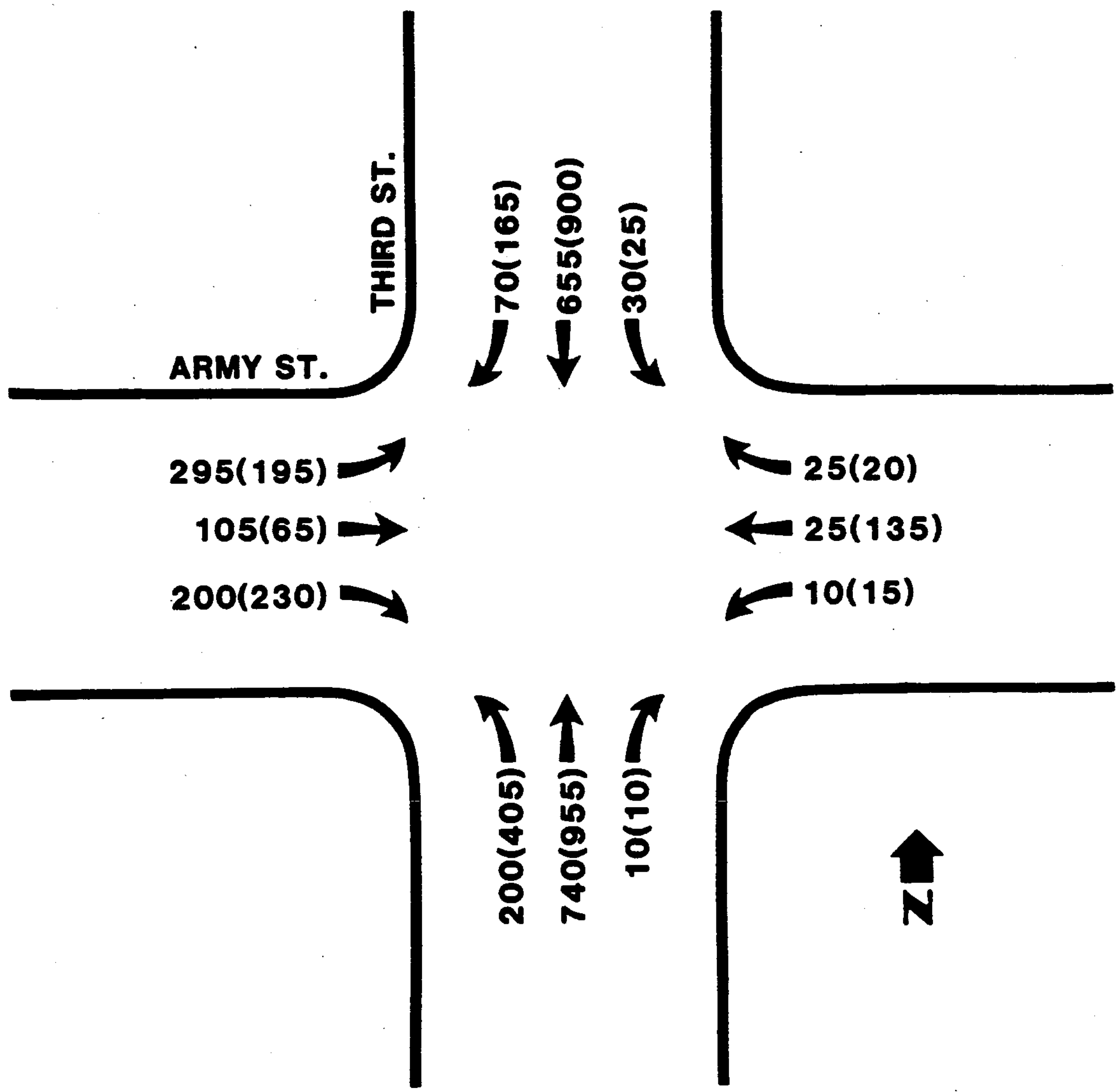



FIGURE 14
MARIPOSA TRAFFIC STUDY

AM(PM) PEAK PERIOD TRAFFIC VOLUMES
THIRD AND ARMY
1986

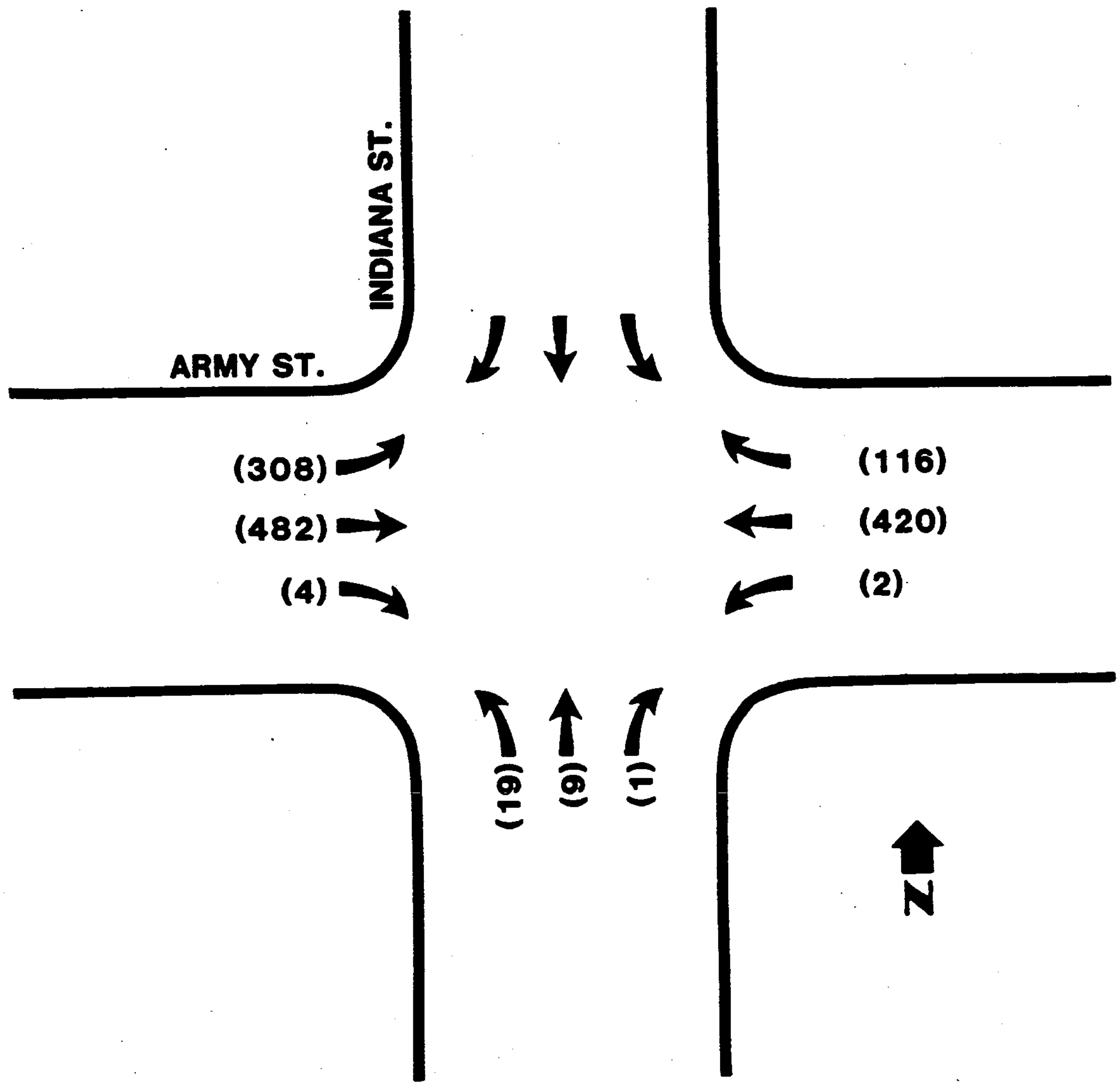



FIGURE 15
MARIPOSA TRAFFIC STUDY

AM(PM) PEAK PERIOD TRAFFIC VOLUMES
ARMY AND INDIANA
10/87

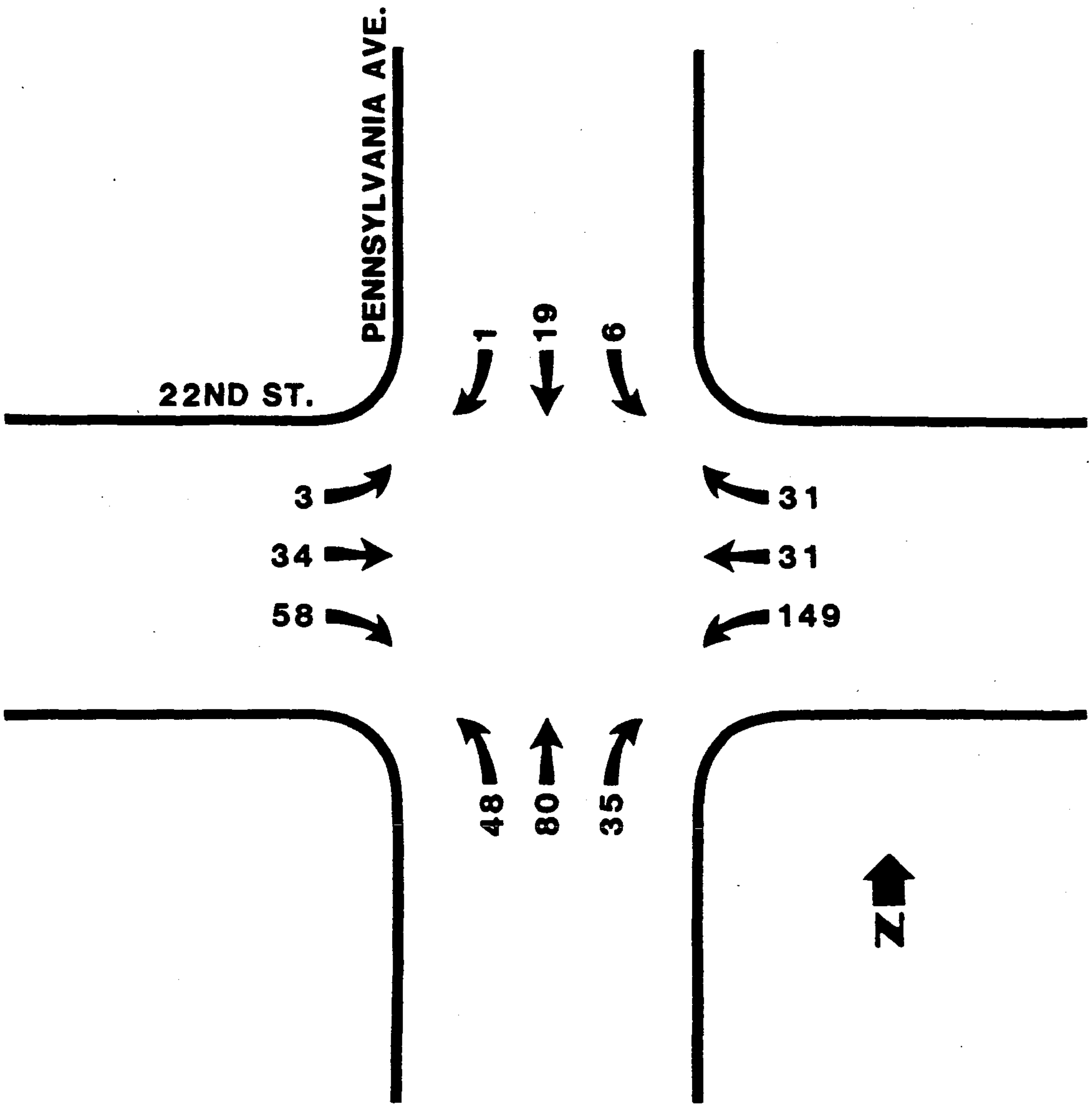



FIGURE 16
MARIPOSA TRAFFIC STUDY

PM PEAK PERIOD TRAFFIC VOLUMES
22ND AND PENNSYLVANIA
1/88

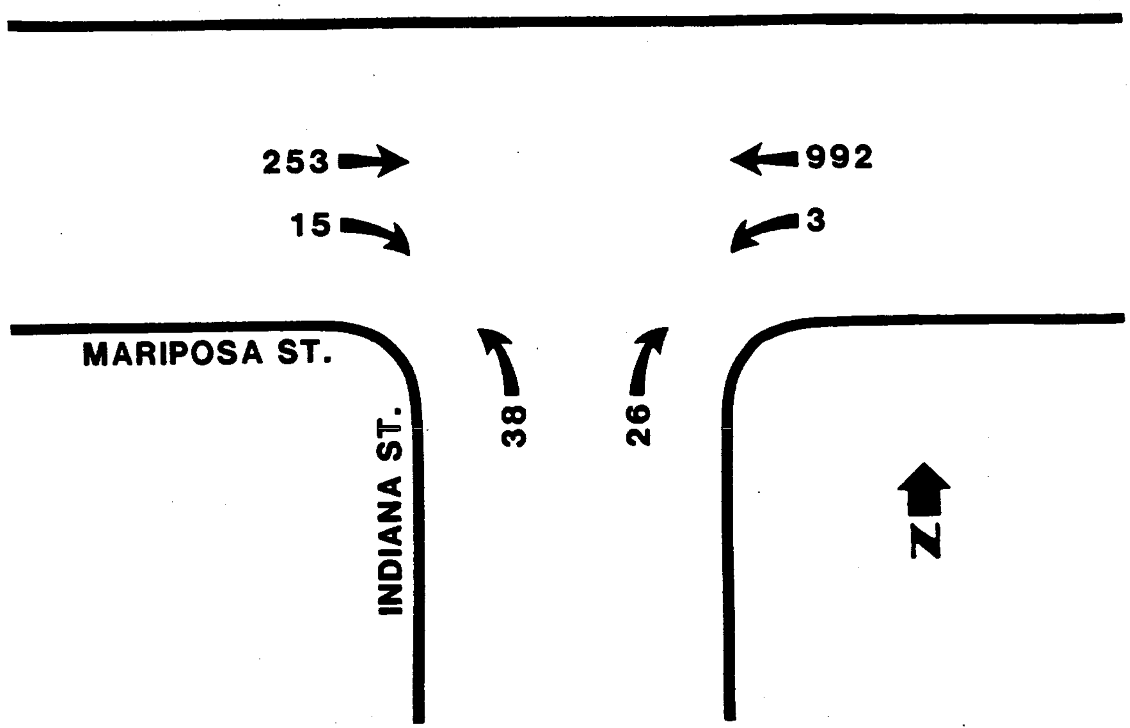



FIGURE 17
MARIPOSA TRAFFIC STUDY

PM PEAK PERIOD TRAFFIC VOLUMES
INDIANA AND MARIPOSA
1/88

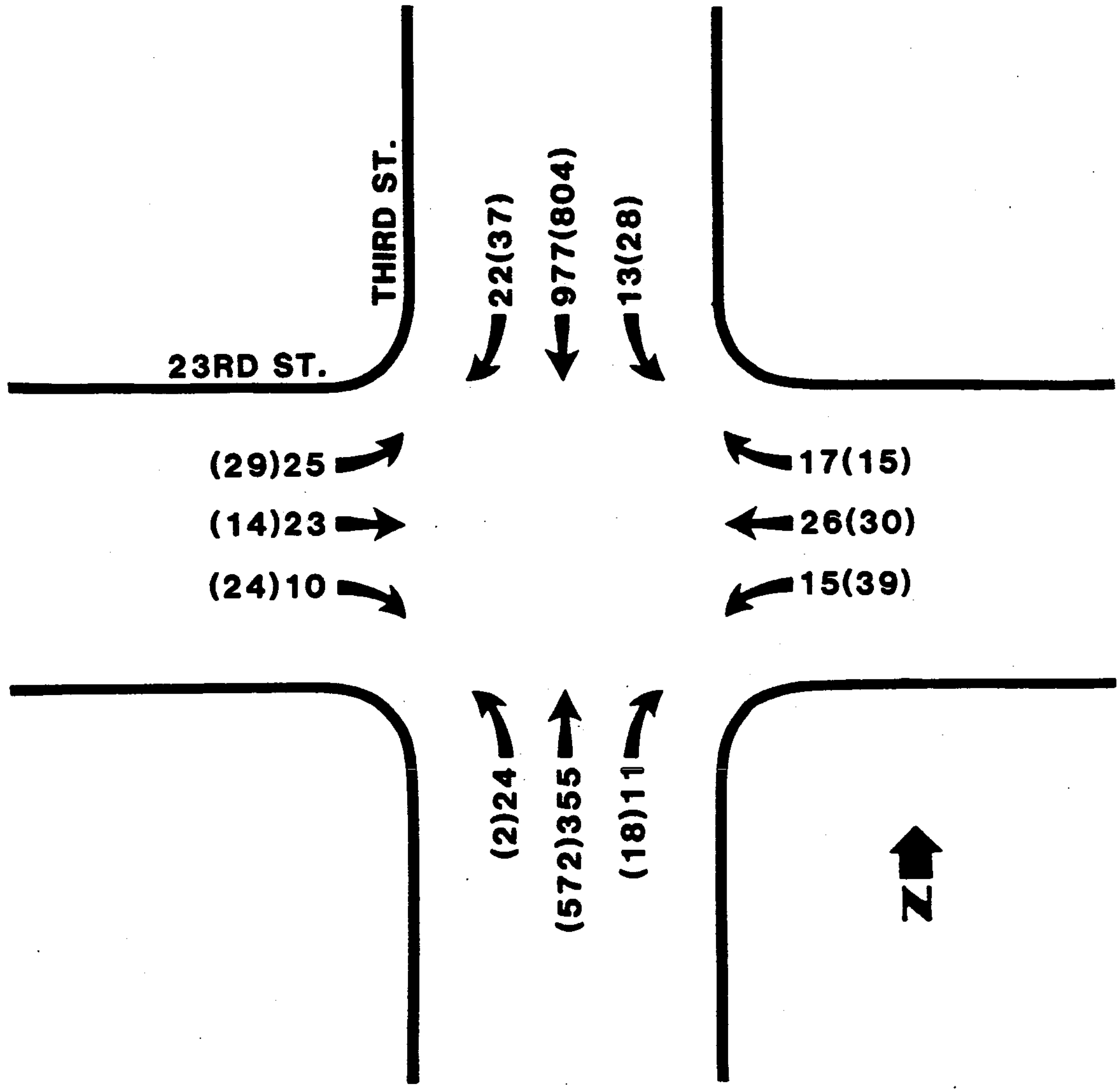



FIGURE 18
MARIPOSA TRAFFIC STUDY

AM(PM) PEAK PERIOD TRAFFIC VOLUMES
THIRD AND 23RD
1/88

from the I-280 ramps on Mariposa Street, the intersection of Third and Mariposa Street and Indiana and Mariposa are the most critical of the intersections likely to be affected by project construction.

In addition to the turning movement counts, traffic was counted on 20th Street appoximately opposite where Michigan Street would intersect if it were cut through. There is no through access on 20th Street east of Illinois Street. Between 8 AM and 9 AM, there were 12 vehicles inbound and 14 vehicles outbound including 69% trucks. There were many other vehicles entering and a lessor number leaving the street at the intersection of 20th and Illinois, but these other vehicles either parked at the west end of the street or went to and from a mid-block destination adjacent to Todd Shipyard facilities.

Truck Counts

Truck counts were also performed at all of the turning movement count locations. Table 1 summarizes the results. Trucks comprise about 10% of the north/south traffic on Third Street in the AM and PM peak periods. This percentage is generally higher in off-peak periods. The percentage of trucks is generaly higher at the other locations examined.

**TABLE 1. PERCENTAGE OF TRUCKS**

| Location | Direction | Time Period | % Trucks |
|---|---|---|---|
| Third/Mariposa | N/S through | 4:30-5:30 pm | 9 |
| Third/Mariposa | All | 4:30-5:30 pm | 7 |
| Third/22nd | All | 7:30-8:30 am | 10 |
| Third/22nd | All | 8:30-9:00 am | 15 |
| Army/Indiana | All | 4:00-5:30 pm | 17 |
| Illinois/Mariposa | All | 4:00-5:00 pm | 8 |
| Illinois/20th | All | 7:30-8:30 am | 16 |
| Illinois/20th | All | 8:30-9:00 am | 29 |
| East end of 20th Street | All | 7:30-9:00 am | 67 |
| Third/23rd | N/S through | 7:30-8:30 am | 10 |
| Third/23rd | N/S through | 4:30-5:30 pm | 15 |

Peak Hour Factor

The peak hour factor (PHF)is the ratio of the traffic flow rate in the peak hour to the traffic flow rate in the busiest 15 minutes of the peak hour. It is a measure of the utilization of the peak hour capacity and can range from about 0.7 to 0.9 or higher. For the intersections examined, the PHF for the major north/south movements ranged from 0.86 to 0.93 in both the AM and PM peak periods. These values are fairly typical for urban areas.

## STREET CAPACITIES AND LEVELS OF SERVICE

All intersections and streets in the study area appeared to be operating within capacity and most have significant reserve capacity during peak-hour conditions. Operational level of service (LOS) analyses were conducted for the intersections potentially affected by project construction. Table 2 summarizes the results of the analyses. Level of service definitions are given in Table 3. Appendix B includes the LOS calculations.

**TABLE 2. INTERSECTION LEVEL OF SERVICE**

| Intersection | Level of Service (AM/PM) |
|---|---|
| Third/Mariposa | C/B |
| Third/20th | B |
| Third/22nd | B |
| Third/23rd | A/A |
| Third/Army | C/C-D* |

*The SB approach of Third Street approaches LOS F during the PM peak period, creating LOS D for the intersection as a whole. If SB RT traffic uses the bus zone as a right turn lane, conditions improve somewhat.

The unsignalized intersections of Illinois/Mariposa, Illinois/20th (flashing red light on all approaches), Army/Indiana, 22nd/Indiana, 22nd/Pennsylvania, and Indiana/Mariposa are also well below capacity. There is some delay on the northbound approach of Army/Indiana while vehicles wait for gaps in the Army Street traffic. While westbound pm and eastbound am volumes along Mariposa between Third St. and the I-280 ramps are substantial, the timing of traffic signals and the absence of heavy cross traffic from Indiana enable traffic to move smoothly through the Mariposa/Indiana intersection.

TABLE 3. DEFINITION OF LEVELS OF SERVICE

| Level of Service | Operational Description | Average Stopped Delay per vehicle (sec)* |
|---|---|---|
| A | Very low delay, extremely favorable progression | $\leq$ 5.0 |
| B | Higher delay, good progression and/or short cycle lengths | 5.1 to 15.0 |
| C | Fair progression and/or longer cycle lengths, occasional individual cycle failures | 15.1 to 25.0 |
| D | Noticeable congestion, unfavorable progression, long cycle lengths, or high v/c ratios, noticeable individual cycle failures | 25.1 to 40.0 |
| E | Limit of acceptable delay, poor progression, long cycle lengths, and high v/c ratios, frequent individual cycle failures | 40.1 to 60.0 |
| F | Unacceptable delay, oversaturation, many individual cycle failures, poor progression and long cycle lengths | > 60.0 |

*Highway Capacity Manual, Special Report 209, Transportation Research Board, National Research Council, Washington, DC. 1985, p. 9-4.

For the other unsignalized intersections, a practical per lane capacity is about 400 to 500 vehicles per hour, well above the peak volumes of 100 to 150 vehicles per hour per lane shown on Figures 12, 13, and 16.

Thus the addition of construction traffic would likely not have significant effect on the level of service of most of the intersections. The only exception is the southbound movement of Third Street at Army Street. Because of existing congestion, additional traffic could become critical here.

However, there is not sufficient capacity to permit a closure of one of the through lanes of Third Street at either Mariposa, 20th, 22nd or 23rd Streets. Analysis of the closure of a northbound lane on Third Street indicated that the resulting level of service would be F with stopped delay of around two minutes in the northbound direction. Traffic would back up between 500 to 600 feet or more during the peak period. Closure of a through lane in off-peak periods (other than 7:00-9:00 AM and 4:00-6:00 PM) would give a level of service of B, no worse than current peak-period operations. Removal of a parking lane would have little if any effect on the level of service.

There is also insufficient capacity to permit closure of two lanes of traffic along Mariposa between Third Street and the I-280 ramps and still maintain two-way traffic flow during the pm peak. It would be necessary to have two lanes open for westbound pm traffic which would require closure of the eastbound lane during the pm peak period. During the am peak one lane of eastbound and one lane of westbound traffic could be sufficient for the traffic volumes.

The installation of the 16-inch force main and 24-inch gravity sewer along Illinois and 23rd Streets may require temporary prohibition of parking on one side to maintain sufficient width for the light two-way volumes. Alternatively, flagmen would be necessary to direct traffic in a two-way single lane.

## HAUL ROUTING

Construction spoils will be hauled from the project sites to the local freeways by the most convenient surface street routes. As shown by Figures 19 and 20, depicting the outbound and inbound haul routes*, there is direct access from the area to both SR-101 and I-280. The following sections discuss the outbound and inbound haul routes in turn.

### OUTBOUND ROUTES

#### Southbound

The most convenient southbound freeway access is to I-280 southbound at either Pennsylvania and 26th Street or further north from Mariposa Street. Because these entrances are north of the I-280/SR-101 junction, these ramps also provide direct access to SR-101. For all project sites but the southern access shaft at Army and Indiana, the most convenient of these two freeway ramps will likely depend on the time of day and the north/south orientation of trucks during loading. Trucks already oriented to the north, i.e., as in loading on the northbound side of the street, will likely find that going north up Third Street or Illinois Street and making a left onto Mariposa Street to be very direct. However, the ramp grades here are steeper than at the Pensylvania/26th Street ramp, and northbound traffic on Third Street is heaviest during the AM peak period.

The Pennsylvania/26th Street ramp can be reached via southbound Third Street to westbound Army Street to northbound Pennsylvania Street. Trucks would have little difficulty at any time of the day turning left onto Third Street from 20th, 22nd Street, or 23rd Street. During PM peak periods, any congestion on southbound Third Street could be avoided by using southbound Pennsylvania Street from the 20th/22nd Street area, but there would be more affect on the residential blocks inbetween.

For the Army/Indiana access shaft, the most direct freeway access is the Pennsylvania/26th Street ramp reached via a left turn onto Army Street from Indiana Street and a right turn onto Pennsylvania Street. Although the intersection is not signalized, the signals at adjacent Pensylvania and Third Streets should create sufficient gaps in the traffic to allow safe access for trucks. The alternative route to this ramp would be via a right turn onto Army Street followed by left turns at the signalized intersections of Third/Army and Third/25th. A more distant possibility is the SR-101 Industrial Street southbound ramp and the I-280 Alemany Boulevard southbound ramp. The SR-101 Army/Bayshore southbound ramp should be avoided because it can be reached only from eastbound Army Street.

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*The 1982 report by Caldwell-Gonzalez-Kennedy-Tudor discussed haul routing in some detail. This section of the report is based in part upon that work, and the haul routing diagrams are adapted from that report.

Map Prepared by: CALDWELL GONZALEZ KENNEDY TUDOR

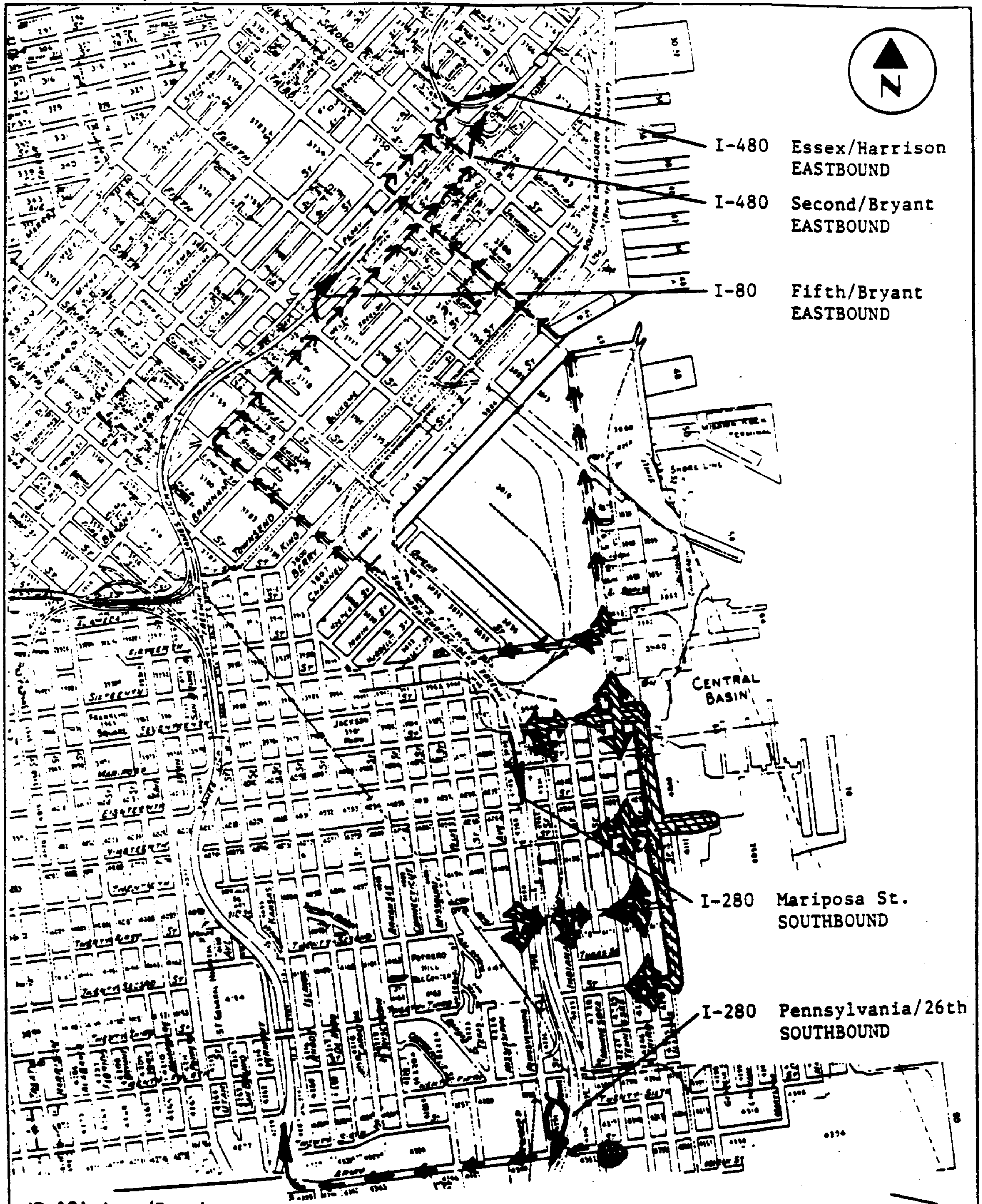



FIGURE 19
MARIPOSA TRAFFIC STUDY

POTENTIAL
OUTBOUND HAUL ROUTES

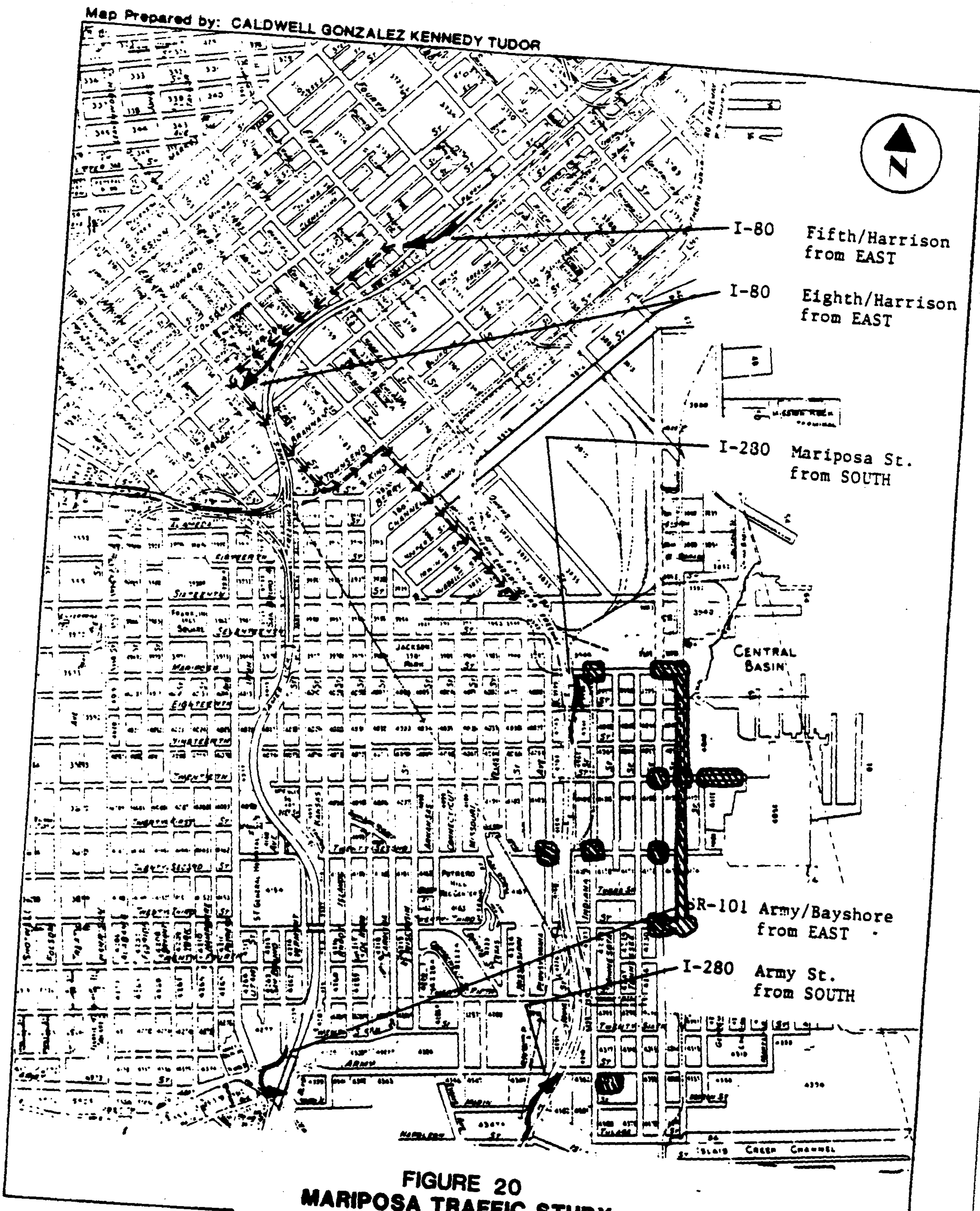



FIGURE 20
MARIPOSA TRAFFIC STUDY

POTENTIAL
INBOUND HAUL ROUTES

North/Eastbound

Because I-280 has no direct connection with the Bay Bridge, the possible freeway access points to the north and east are:

- The SR-101 Army/Bayshore northbound ramp,
- I-80 Fifth/Bryant eastbound ramp,
- I-480 Second/Bryant eastbound ramp, and
- I-480 Essex/Harrson eastbound ramp.

With the exception of the Army/Indiana and Army/Pennsylvania sites, which will find the SR-101 Army/Bayshore northbound ramp to be most direct, the most direct routing will be up Third Street to the northern ramps. Some congestion can be expected on Third Street north of Berry Street in the AM peak period. These northern ramps can frequently be very congested during the PM peak periods because of delays on the Bay Bridge.

**INBOUND ROUTES**

From the South

As shown on Figure 20, the most direct inbound routes from the freeways are at the I-280 northbound ramps at Army Street and at Mariposa Street. The SR-101 Army/Bayshore northbound ramp could also be used. Because there are a significant number of trucks on Army and Third Streets already and because the Third/Army intersection geometry is adequate for trucks, the I-280 Army Street northbound ramp would be the best route. Restrictive geometry will cause heavy trucks to have difficulty making a right turn onto Third Street from Mariposa Street, limiting this route to those going straight through the Mariposa/Third intersection to Illinois Street.

From the North and East

The most direct freeway access from the north and east is from the I-80 westbound ramps at Fifth/Harrison and at Eighth/Harrison. Figure 20 illustrates the most direct route to the project area via Eighth, Townsend, Seventh, 16th, and Third Streets. An alternative access point at the SR-101 Army/Bayshore southbound ramp is made less desirable by a very tight ramp radius leading to eastbound Army Street. The left turns on the northerly route involve minimum traffic conflict because of low volumes and the industrial nature of the streets.

## DETOUR ROUTING

Extensive detour routing is unlikely because the scale of the project sites is limited to tunnel access shafts and sewers 24 inches or less in diameter. Given the width of Third Street, the primary north-south through route in the area, closure of the street is unlikely to be necessary. This situation is fortunate because through traffic routes in the project area are sparse because of the barriers created by the navigable creeks, the San Francisco Bay to the east, and State Route (SR) 101 and hilly topography to the west. The issue is more whether limited detours will be necessary because of partial blockage of Third Street or Pennsylvania Street and/or obstruction of Illinois, Mariposa, Indiana, 20th, 22nd and 23rd Streets. The potential closure of eastbound Mariposa Street at Indiana is the most important of these effects because it would affect traffic from I-280.

### THIRD STREET

Based on preliminary diagrams, it is assumed that the east side of Third Street is more likely to be disrupted than the west side by the tunnel routes. Consequently, the following discussion is first focused on potential disruptions to the northbound side of Third Street. However, the T/S Alternative would connect to a sewer on the southbound side of Third Street, so a limited discussion of the southbound side is also included.

As discussed under level of service, peak-hour traffic volumes on Third Street are too heavy to permit closure of one of the traffic lanes without severe congestion. If a northbound lane were closed in the AM peak period, stopped delay would average two minutes for the restricted traffic at each affected intersection and traffic would back up 500 to 600 feet or more, blocking adjacent intersections.

A traffic lane can be taken out of service at off-peak times (9:00 AM to 4:00 PM, 6:00 PM to 7:00 AM weekdays) without adverse congestion. Likewise, a parking lane can be closed at any time.

Short detours involving parallel streets on either side of Third Street do not look very promising for peak-period traffic. None of the streets have a capacity large enough to avoid encountering delays of the same magnitude that would be caused by closing a through traffic lane on Third Street. Additionally for northbound traffic, Illinois Street is the only parallel street that would not require a left turn across southbound Third Street traffic, but Illinois Street is likely to also be faced with construction impacts. Similar conditions apply to the southbound side.

Evening and late night detours of the northbound traffic could be accomplished without undue delay or significant additional distance if Illinois Street were open for use as a detour route. Otherwise, northbound traffic would have to be routed left across Third Street.

Although the delay in the late evening would not be significant, the residential areas to the west of Third Street would be affected. The southbound off-peak traffic could be routed to the west around the 23rd Street intersection with similar effect

Consequently, it is recommended that peak-period disruptions be confined to closure of only a parking lane. Should more extensive closure be needed, northbound though traffic should be routed around the area via Army Street and I-280 or SR-101. Likewise, southbound traffic should be routed around the area via Mariposa Street, I-280, Pennsylvania, and Army Streets.

**MARIPOSA STREET**

As discussed under level of service, peak-hour traffic volumes along Mariposa Street are very heavy at the Mariposa/Third Street and Mariposa/Indiana Street intersections. Major volumes occur during the am and pm peak because of autos entering and exiting I-280. As illustrated by Figure 17, the heaviest volumes occur during the pm peak when over 900 autos travel westbound along Mariposa west of Third Street. The am volumes are somewhat lighter with approximately 500 autos traveling eastbound (see Figure 9).

In order to install the access shaft at the Mariposa/Indiana intersection, closure of two traffic lanes would probably be required. Given the heavy pm traffic volumes, closure of westbound pm peak traffic lanes should not occur. Therefore, closure of pm eastbound traffic along Mariposa would be necessary. This would necessitate re-routing pm I-280 exiting eastbound traffic west along Mariposa to Mississippi or to Pennsylvania Street. From these two streets traffic could either continue north to 16th or south to 20th Street, from where it could connect to Third Street or disperse more generally throughout the area. AM traffic volumes are low enough to permit one lane in each direction during the am peak. During off-peak periods volumes would be low enough to allow one lane in each direction along Mariposa.

Although traffic is generally light on Mariposa Street between Third and Illinois, this street cannot be closed during daylight hours because of required access by businesses along or at the ends of this street. Likewise, Mariposa between Third and the I-280 ramps cannot be closed during daylight hours because of the substantial traffic generated by the I-280 access ramps.

The closure of the intersection of Mariposa Street with Illinois Street would be possible because alternate routes are available. A circuitous detour up to Mission Rock Street would be required to access China Basin Street from the south. The closure of Indiana Street's access to Mariposa would also be possible because traffic along this street is very light and could be re-routed to Tennessee, Third, or Pennsylvania in order to access I-280 via Mariposa.

Therefore, it is recommended that pm peak period disruptions along Mariposa west of Third Street be confined to the re-routing of I-280 exiting traffic and other eastbound Mariposa traffic along Mariposa to Pennsylvania or Mississippi where traffic can continue northbound or southbound. During the am peak one lane eastbound and one lane westbound should be kept open for traffic.

Mariposa between Illinois and Third may be closed if access is provided to adjacent businesses. Along Illinois east of Third Street it is recommended that parking be restricted as necessary to maintain adequate traveled way width.

**ILLINOIS, INDIANA, 20TH, 22ND AND 23RD STREETS**

A key issue in the closure or partial blockage of Illinois, Indiana, 20th, 22nd and 23rd Street is the need to provide access to businesses along these streets. In particular, the intersections of 20th and 22nd Streets with Illinois Street must be kept open to provide access to those dead end streets east of Illinois Street. Additionally, the intersection of 22nd and Indiana provides through access to Pennsylvania and Third Streets, important north/south access routes. 23rd Street could be closed with minimal disruption to traffic flow.

If access to the businesses is assured, none of the streets is so busy that it could not be restricted to one lane with flagmen directing traffic, which would permit the closure of a through traffic lane and removal of the parking. Through traffic could also be routed around a construction area via Third Street and unaffected cross streets with minimal impact on either the through traffic or the streets used as detour routes.

## RESTRICTIONS FOR STREETS ACCESSING CANDLESTICK PARK

As illustrated by Figure 21, designated streets are not to have work in progress or any lane blockage on game days at Candlestick Park between 11AM and 5PM on day events and 4PM to Midnight on night events. Since all of the streets indicated are outside of the Mariposa project area, construction activities for this project are not subject to the ball park restrictions.

LEGEND

Streets to have no work in progress or any lanes blocked on game days at Candlestick Park between 11AM and 5PM on day events and 4PM to Midnight on night events.

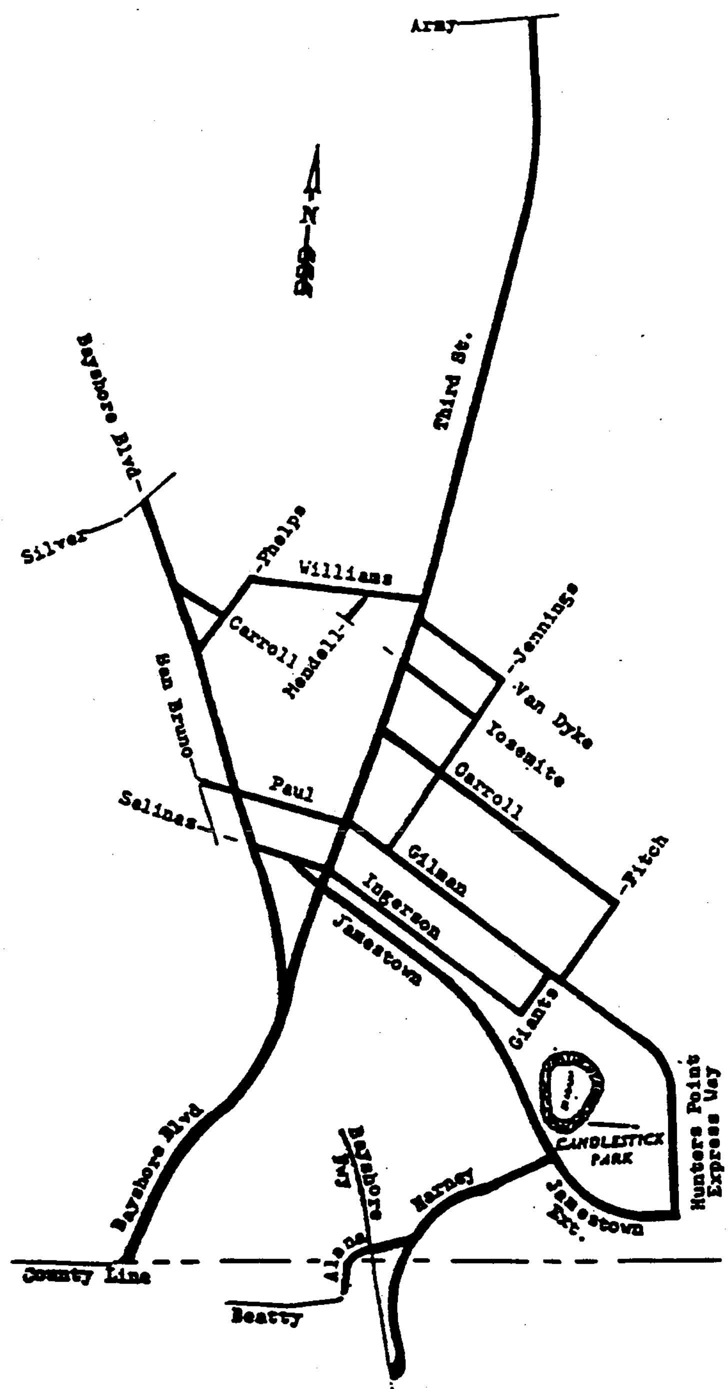



**FIGURE 21**
**MARIPOSA TRAFFIC STUDY**

**RESTRICTIONS FOR BALL PARK STREETS**

## POTENTIAL TRAFFIC IMPACTS AND MITIGATION MEASURES

Based on the information presented above, the following subsections summarize the potential traffic impacts of and proposed mitigation measures for the seven alternatives described previously. Because the alternatives have overlapping affects, the summary of identical impacts is not repeated for subsequent alternatives.

### ALTERNATIVE T-1A

Potential traffic impacts of Alternative T-1A include:

1. Third/Mariposa Streets intersection is affected by an entry shaft with heavy peak period traffic on both Third Street and Mariposa Street west of Third Street. The intersection is traversed by the 15 Third Street bus, which is heavily utilized and has very frequent peak and off peak service. Although alternate routes exist, the intersection cannot be closed or even restricted to one through lane in each direction during peak periods without severe congestion.

2. Third/20th Streets intersection is affected by an entry shaft with heavy peak period traffic on Third Street. The intersection is traversed by the 15 Third Street, 22 Fillmore, and 48 Quintara buses. The first two are heavily utilized and have very frequent peak and off peak service. The 22 Fillmore is traverses only the southbound side of the street but is particularly vulnerable to disruption because it is an electric trolley. Although alternate routes exist, the intersection cannot be closed or even restricted to one through lane in each direction during peak periods without severe congestion.

3. Trench and working areas would occupy a portion of Mariposa Street between Third and Illinois Streets. Weekday traffic is light enough to leave only one lane open with flagmen for control, but access to businesses must be maintained along the street.

4. Illinois/Mariposa Streets intersection is affected by an entry shaft with light weekday traffic on both Illinois Street and Mariposa Street. The intersection could be closed or traffic required to share use of only one lane on each street provided flagmen were available for traffic control during peak hours. Closure would require a circuitous detour to reach China Basin Street. The Santa Fe has railroad tracks down Illinois Street. It is not currently known if these tracks are required for industry service.

5. 20th Street is affected by an entry shaft approximately opposite Michigan Street and a new sewer pipe between the access shaft and the easterly end of 20th street. Trench and working areas would partly occupy this section of 20th Street. Weekday traffic is light enough to leave only one lane open with flagmen for control but access to businesses must be maintained along the deadend street.

6. The southeast corner of Army/Indiana Streets is affected by an entry shaft but no impact expected on the traffic ways. Weekday traffic is light on Indiana Street but Army Street has relatively heavy peak period volumes.

Proposed mitigation measures of Alternative T-1A include:

1. Avoid closure of the Third/Mariposa intersection. Keep two through traffic lanes open in each direction on Third Street during peak periods and keep one through traffic lane open during off peak periods.

2. Avoid closure of the Third/20th intersection. Keep two through traffic lanes open in each direction on Third Street during peak periods and keep one through traffic lane open during off peak periods. Avoid disruption of the 22 Fillmore bus.

3. Avoid closure of the Illinois/Mariposa intersection during peak periods. Provide adequate detour signing other times.

4. Avoid closure of the Mariposa Street between Third and Illinois Streets. Maintain access to businesses. Provide flagmen for traffic control if only one thorugh lane is maintained.

5. Avoid closure of the 20th Street east of Illinois Street. Maintain access to businesses. Provide flagmen for traffic control if only one through lane is maintained.

6. Coordinate with the Santa Fe railroad to determine if railroad access is still required on Illinois Street, and how best to provide it if so.

7. Coordinate with the Fire Department to maintain clear fire access paths.

8. Utilize proper street signing and delineation techniques in the construction zones to maintain safety.

9. Trench bridging may be required at active driveway points, e.g., at the cement plant on Mariposa Street, if alternate access is unavailable.

**ALTERNATIVE T-1B**

1. Illinois/Mariposa Streets intersection is affected by an entry shaft with light weekday traffic on both Illinois Street and Mariposa Street. The intersection could be closed or traffic required to share use of only one lane on each street provided flagmen were available for traffic control during peak hours. Closure would require a circuitous detour to reach China Basin Street. The Santa

Fe has railroad tracks down the street. It is not currently known if these tracks are required for industry service.

2. Illinois/20th Streets intersection is affected by an entry shaft with light weekday traffic on both Illinois Street and 20th Street. The intersection provides access to businesses on deadend 20th Street and cannot be closed. Traffic could be required to share use of only one lane on each street provided flagmen were available for traffic control during peak hours. The Santa Fe has railroad tracks down Illinois Street. It is not currently known if these tracks are required for industry service.

3. 20th Street is affected by an entry shaft approximately opposite Michigan Street and a new sewer pipe between the access shaft and the easterly end of 20th street. Trench and working areas would occupy this section of 20th Street. Weekday traffic is light enough to leave only one lane open with flagmen for control but access to businesses must be maintained along the deadend street.

4. Third/22nd Streets intersection is affected by an entry shaft with heavy peak period traffic on Third Street. The intersection is traversed by the 15 Third Street and 48 Quintara buses. The first one is heavily utilized and has very frequent peak and off peak service. Although alternate routes exist, the intersection cannot be closed or even restricted to one through lane in each direction during peak periods without severe congestion.

5. The southeast corner of Army/Indiana Streets is affected by an entry shaft but no impact expected on the traffic ways. Weekday traffic is light on Indiana Street but Army Street has relatively heavy peak period volumes.

Proposed mitigation measures of Alternative T-1B include:

1. Avoid closure of the Third/22nd intersection. Keep two through traffic lanes open in each direction on Third Street during peak periods and keep one through traffic lane open during off peak periods.

2. Avoid closure of the Illinois/Mariposa intersection during peak periods. Provide adequate detour signing other times.

3. Avoid closure of the Illinois/20th intersection. Provide flagmen for traffic control during peak periods if only one through lane is maintained.

4. Avoid closure of the 20th Street east of Illinois Street. Maintain access to businesses. Provide flagmen for traffic control if only one through lane is maintained.

5. Coordinate with the Santa Fe railroad to determine if railroad access is still required on Illinois Street, and how best to provide it if so.

6. Coordinate with the Fire Department to maintain clear fire access paths.

7. Utilize proper street signing and delineation techniques in the construction zones to maintain safety.

8. Trench bridging may be required at active driveway points if alternate access is unavailable.

**ALTERNATIVE T-1C**

The impacts and proposed mitigations measures are identical to those of Alternative T-1B.

**ALTERNATIVE T-2A**

The impacts and proposed mitigations measures are identical to those of Alternative T-1A with the exception of the substitution of Third/22nd for Third/20th. Impacts and proposed mitigations for Third/22nd are discussed under Alternative T-1B. Also, 20th Street would have no access shaft but the impacts and mitigations remain unchanged because of a proposed 7-foot sewer pipe just west of the existing pump station.

**ALTERNATIVE T-2B**

The impacts and proposed mitigations measures are identical to those of Alternative T-1B with the exception that there would be no impact on the intersection of Illinois/20th Streets. Also, 20th Street would have no access shaft but the impacts and mitigations remain unchanged because of a proposed 7-foot sewer pipe just west of the existing pump station.

**ALTERNATIVE T-3**

Potential traffic impacts of Alternative T-3 include:

1. Mariposa/Indiana intersection is affected by junction structure with heavy peak period traffic along Mariposa Street. Because of heavy traffic volumes during the am and pm peak Mariposa cannot be closed without severe congestion.

2. 22nd/Indiana intersection is affected by junction structure with light weekday traffic on both Indiana Street and 22nd Street. This intersection should not be closed because of its proximity to the MUNI facility and the importance of 22nd Street as a through route between Pennsylvania and Third Streets. Traffic could, however, be required to use only one lane on each street provided flagmen were available for traffic control during peak hours.

3. 22nd/Pennsylvania intersection is affected by junction structure with light weekday traffic on both Indiana and 22nd Street. Weekday traffic is light enough to leave only one lane open with flagmen for control, but access to businesses must be maintained along the street.

4. 20th Street is affected by a 7-foot diameter sewer pipe just west of the existing pump station. Trench and working areas would occupy a portion of 20th Street between Michigan Street and the easterly end of the street. Weekday traffic is light enough to leave only one lane open with flagmen for control but access to businesses must be maintained along the deadend street.

Proposed mitigation measures of Alternative T-3 include:

1. Avoid closure of Mariposa Street. Keep two westbound through lanes open during the pm peak and one westbound and eastbound lane open during the am peak. Northbound exits from I-280 to Mariposa would be re-routed to the west at the ramp's intersection with Mariposa. Detour westbound Mariposa Street traffic via 20th, 22nd, and 16th Streets.

2. Avoid closure of 22nd/Indiana intersection. Maintain access to businesses and MUNI facility. Provide flagmen for traffic control if only one through lane is maintained.

3. Avoid closure of 22nd/Pennsylvania intersection. Maintain access to businesses. Provide flagmen for traffic control if only one through lane is maintained.

4. Avoid closure of 20th Street east of Illinois Street. Maintain access to businesses. Provide flagmen for traffic control if only one through lane is maintained.

**ALTERNATIVE T/S**

1. Illinois/Mariposa Streets intersection is affected by T/S box with light weekday traffic on both Illinois Street and Mariposa Street. The intersection could be closed or traffic required to share use of only one lane on each street provided flagmen were available for traffic control during peak hours. Closure would require a circuitous detour to reach China Basin Street. The Santa Fe has railroad tracks down Illinois Street. These tracks are required for industry service.

2. Third/23rd Streets intersection is affected by a 24-inch sewer with heavy peak period traffic along Third Street. The intersection is traversed by the 15 Third Street and 48 Quintara buses. The first one is heavily utilized and has very frequent peak and off peak service. Although alternative routes exist, the intersection cannot be closed to north/south through traffic without severe congestion.

Turning movements from 23rd Street, however, are very light and access from 23rd could be terrporarily eliminated as long as access from 22nd to the MUNI facility was provided.

3. 20th Street is affected by a 7-foot diameter sewer pipe and a 10-inch force main just west of the existing pump station. Trench and working areas would occupy 20th Street east of Illinois Street. Weekday traffic is light enough to leave only one lane open with flagmen for control but access to businesses must be maintained along the deadend street.

Proposed mitigation measures of Alternative T/S include:

1. Avoid closure of Mariposa/Illinois during peak periods. Provide adequate detour signing other times. If limitation to one lane is required during peak periods, provide flagmen for traffic control. Mariposa Street between Illinois and Third may be closed if access is provided to adjacent businesses and through traffic deterred on 19th or 20th Street.

2. Coordinate with the Santa Fe railroad to determine how best to provide access.

3. Avoid closure of 23rd/Third Streets intersection. Keep two through lanes open in each direction on Third Street during peak periods and keep one through traffic lane open during off peak periods.

4. Restrict parking on Illinois as necessary to maintain adequate traveled way width (20 feet) during installation of the 16-inch force main and the 24-inch gravity sewer.

5. Avoid closure of the Illinois/20th intersection. Provide flagmen for traffic control during peak periods if only one through lane is maintained.

6. Avoid closure of 20th Street east of Illinois Street. Maintain access to businesses. Provide flagmen for traffic control if only one through lane is maintained.

**ALTERNATIVE PS/RESERVOIR**

The impacts and proposed mitigation measures are identical to those of Alternative T/S.

APPENDIX D

# SAN FRANCISCO CLEAN WATER PROGRAM
# CITY AND COUNTY OF SAN FRANCISCO

# BAYSIDE FACILITIES PLAN

## EXPANDED GEOTECHNICAL INVESTIGATION
## ELEMENT 6: MARIPOSA TRANSPORT/STORAGE FACILITY

## AUGUST 1982

cgkt CALDWELL · GONZALEZ · KENNEDY · TUDOR
CONSULTING ENGINEERS

## TABLE OF CONTENTS

# INTRODUCTION

## GENERAL STATEMENT

This report presents the Expanded Geotechnical Program investigation for Element 6, Mariposa Transport/Storage Facility, of the Bayside Facilities Planning Project. It provides specific geotechnical findings, conclusions, and recommendations for design of the Mariposa Transport/Storage Facility (MTSF), and is to be used in conjunction with the "Geotechnical Reference Report", which outlines the eight project elements and provides the geotechnical setting for the project. Figure 1 - Location Map, shows the location of the MTSF.

This work is preceded by the "Final Geotechnical Report, Bayside Facilities Plan", March 1981, which provided geotechnical criteria for the evaluation of alternative sites and alignments for the eight project elements.

## PROPOSED PROJECT

The MTSF comprises pipelines of 96-, 72-, and 18-inch diameter, a 5 million gallon per day pump station, and a 1.5 million gallon covered reservoir. These structures are illustrated on Plate 1 - Site Plan.

Pipelines. The 96-inch pipeline will be installed along Twentieth Street immediately west of the existing Twentieth Street Pump Station. It will be 170 feet long and its invert will be at El. -18 feet, 16 to 18 feet below ground surface. All elevations referenced in this report are based on San Francisco City Datum, SFCD.

The proposed reservoir will be connected to an existing sewer beneath Mariposa Street by two 72-inch pipes, 45 and 150 feet long, respectively. The pipes will have an invert at El. -12 feet, approximately 15 feet below ground surface.

The 18-inch pipeline will be a total of 3,450 feet long, and will run from the proposed pump station to an existing sewer

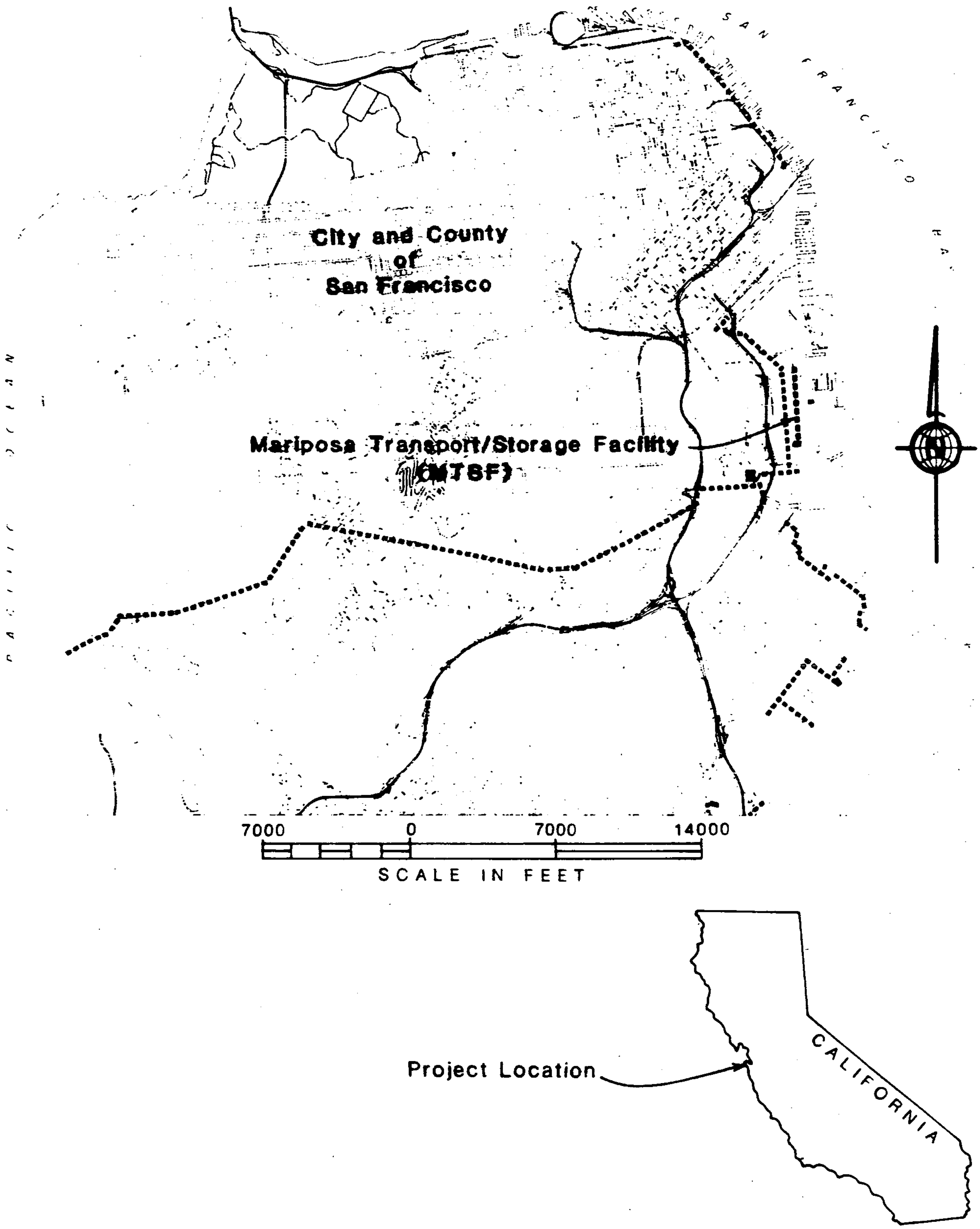



**Fig. 1**
**Location Map**
CALDWELL-GONZALEZ-KENNEDY-TUDOR
A JOINT VENTURE

at the intersection of Twenty-third and Third Streets. The pipeline will extend east along Mariposa Street from the pump station to Illinois Street, cross under a set of railroad tracks, then extend south along Illinois Street to Twenty-third Street, and finally turn and extend west along Twenty-third Street to Third Street. The invert of the proposed pipeline will vary from El. -10 feet to El. +10 feet along the alignment, 10 to 12 feet below ground surface.

Due to traffic and utilities, the 18-inch pipe will be jacked or augered under the Illinois and Twenty-third Streets intersection and from the edge of Third Street to the connection with the existing sewer in Third Street. The remaining sections of 18-inch pipe and all of the 72- and 96-inch pipes will be placed in open trenches.

Pump Station and Reservoir. The pump station and reservoir facility will be located on the southwest corner of Mariposa and Illinois Streets. The pump station and attendant odor control and flushing buildings will be 30 feet wide, 100 feet long, and will have an invert at El. -38.6 feet. To the east of the pump station, the reservoir will consist of four 100-foot by 25-foot basins with a minimum invert elevation of -32 feet and a maximum water level of El. -7 feet. The top of the pump station building will be above ground at El. +15 feet, while the top of the reservoir will be below the present ground surface at El. -4 feet.

## WORK PERFORMED

Work performed for this investigation has included:

1. A review of the published and unpublished geotechnical literature.
2. The drilling of 9 exploratory borings to provide information on the subsurface conditions.

3. Geologic field mapping to determine the character of the bedrock in the project area.
4. Field and laboratory testing to define the engineering properties of the earth materials encountered.
5. Analysis of findings for feasibility assessment, seismic design considerations, excavation characteristics, foundation support, and construction considerations.
6. Preparation of this report.

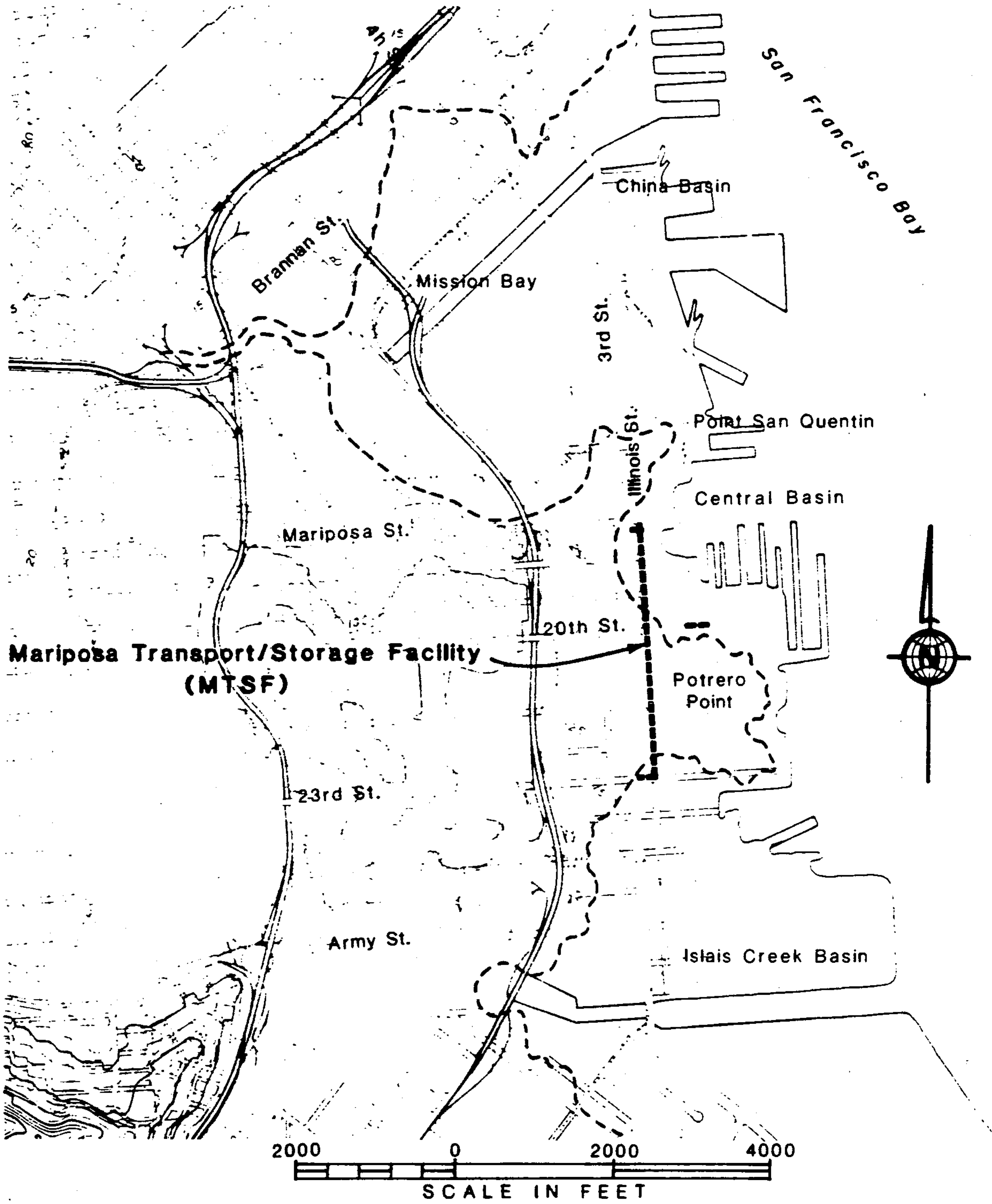
Three exploratory borings were drilled for the pump station and reservoir, and six borings were drilled along the alignment of the various pipelines. The locations of the exploratory borings drilled for this study are shown on Plate 1. Data obtained from exploration and laboratory testing programs is presented in the Appendix to this report.

## FINDINGS

### SITE CONDITIONS

The proposed MTSF is located within an industrial area along the San Francisco waterfront. Most of the area is occupied by industrial facilities, warehouses, oil and gas storage tanks, railroads, and streets, and numerous underground and overhead utilities exist. The ground surface varies from El. 0 feet to El. +22 feet at the site of the proposed facilities, but rises to greater than El. +300 feet on Potrero Hill only 3,000 feet to the west.

Much of the land surrounding the proposed facilities was reclaimed from San Francisco Bay during the latter half of the 19th century (Dow, 1973). The relationship of the former shoreline to the MTSF is shown on Figure 2 - Historic Shorelines. Fill materials consist primarily of gravel and broken rock obtained from Potrero Hill, but also include sand, soft clay




LEGEND

Shoreline (1849)

Mariposa Transport/Storage Facility

**Fig. 2**
**Historic Shoreline**

CALDWELL-GONZALEZ-KENNEDY-TUDOR
A JOINT VENTURE

dredged from San Francisco Bay, sunken ships, building rubble, organic wastes, and other debris. As shown on Figure 2, the proposed pump station, reservoir, 96-inch pipe, 72-inch pipes, and all but the central section of the 18-inch pipe are located within the reclaimed area.

GEOLOGY

The MTSF is located on the eastern side of the San Francisco Peninsula, entirely within the Fort Point-Hunters Point shear zone. Bedrock lithologies encountered in the shear zone include cataclasite and serpentinite with minor amounts of gabbro, sandstone, shale, chert, and greenstone. The data and tectonic models presented in the Geotechnical Reference Report suggest that serpentinite of the Fort Point-Hunters Point shear zone was derived by hydrothermal alteration of gabbros, dunites, and harzburgites that originally formed the base of the Mid Jurassic Coast Range ophiolite. The gabbro inclusions observed in the shear zone are probably remnants of the original igneous rock. Although the parental material is approximately 160 million years old, inclusions of Late Jurassic to Late Cretaceous Franciscan sandstone, shale, chert, and greenstone in both the serpentinite and the cataclasite indicate that structural emplacement of the serpentinite and formation of the cataclasite significantly post-date crystalization of the parental magma.

At the pump station and reservoir site and along the pipeline alignments, the bedrock lithologies of the Fort Point-Hunters Point shear zone are generally overlain by artificial fill and/or surficial deposits of younger bay mud, bay side sands, older bay mud, and colluvium/alluvium. These units are shown on Plates 2.1 through 2.4 - Plan and Geotechnical Profile, and occur in the subsurface in the stratigraphic succession outlined below:

| | |
|---|---|
| Historic (0-200 years old) | Artificial fill (af) |
| Holocene to Pleistocene (0-1.8 million years old) | Younger bay mud (Qyb) |
| | Bay side sands (Qbs) |
| | Older bay mud (Qob) |
| | Colluvium/Alluvium (Qsr) |
| Cretaceous to Jurassic (65 to 165 million years old) | Franciscan Formation |
| | sandstone (KJss) |
| | shale (KJsh) |
| | chert (KJc) |
| | greenstone (KJg) |
| | cataclasite (KJu) |
| | Serpentinite (sp1, sp2) |
| | Gabbro (gb) |

Bedrock lithologies are not well exposed in the vicinity of the MTSF. Outcrops near the facility are limited to the area between Nineteenth and Twenty-second Streets, where chert, sandstone, cataclasite, and serpentinite are found at the ground surface or beneath a thin layer of artificial fill (refer to Plate 1). These outcrops are the remnants of Potrero Point, an extension of Potrero Hill which stood up to 100 feet above the Bay before being leveled for development. North and south of this area the bedrock surface drops off quickly. Beneath the proposed pump station and reservoir site, bedrock was encountered at El. -39, -59, and -68 feet in Borings 6-1, 6-2, and 6-3, respectively. In addition, south of Twenty-second Street, the bedrock surface drops from El. +18 feet in Boring 6-13 to below El. -22 feet in Boring 6-12.

Although data on geologic structure near the MTSF is scarce, the orientation of the major shear foliations in the serpentinite is probably consistent with the northwest strike and shallow to moderate northeast dip of the well developed shear foliations observed in other parts of the Fort Point-Hunters Point shear zone (refer to the Geotechnical Reference Report). This structural attitude has also been used to infer the general orientation of the apparently lenticular inclusions of sandstone, shale, chert and greenstone that occur in the serpentinite of the Fort Point-Hunters Point shear zone (refer to Plates 2.1 through 2.4).

The lack of bedrock exposure in the vicinity of the MTSF and the general dispersion of the joint and fracture orientations observed at the Islais Creek Storage/Treatment Facility site (Caldwell-Gonzalez-Kennedy-Tudor, 1982) suggest that no definitive analysis of structural discontinuities along the MTSF may be made at this time.

EARTH MATERIALS

Artificial Fill (af). Deposits of artificial fill blanket most of the area and reach a maximum thickness of 24 feet in Borings 6-6 and 6-8. The fill is composed of heterogeneous mixtures of gravel (GW, GP, GM, GC), sand (SM, SC), silt (ML), and clay (CL), that locally contain wood, glass, cobble to boulder size brick and concrete blocks, soft clay, and industrial debris.

Engineering properties of the fill vary considerably. Relatively clean sand and gravel such as the materials encountered in Boring 6-1 at a depth of 1 to 6 feet and in Boring 6-12 at a depth of 1 to 23 feet are highly permeable, while the clayey materials such as those encountered in Boring 6-7 at a depth of 4 to 15 feet are relatively impermeable. The granular materials range in density from very loose to medium dense, and the cohesive materials are generally soft and nonplastic to highly plastic (see the log of Boring 6-3).

The 96- and 72-inch pipes will be located entirely within artificial fill, while the 18-inch pipe will be located in artificial fill for only part of its length and in bedrock beneath the artificial fill for the remainder of its length (see Plates 2.1 through 2.3). Although artificial fill materials exist at the pump station and reservoir site, the structures will extend well below the base of the fill layer (see Plate 2.4).

Younger Bay Mud (Qyb). Younger bay mud was encountered beneath the artificial fill in Borings 6-1, 6-2, 6-3, 6-6, 6-7, and 6-8, and reaches a maximum thickness of 19 feet in Boring 6-3. The younger bay mud comprises clay and silty to sandy clay (CL, CH) with minor amounts of clayey silt (ML). Typically, the material is dark gray to green gray, saturated, soft to stiff, impermeable, and underconsolidated to normally consolidated. Laboratory tests indicate that the younger bay mud has an average dry density of 80 pounds per cubic foot (pcf), moisture content of 49 percent, liquid limit of 54 percent, plastic limit of 23 percent, and torvane shear strength of 930 pounds per square foot (psf).

The younger bay mud will occur within the excavation for the pump station and reservoir, and will be beneath the bottom of the excavations for the 96-, 72-, and the northern portion of the 18-inch pipes (see Plates 2.1 through 2.4). In all cases, the invert of the pipes will be at least five feet above the top of the younger bay mud.

Bay Side Sands (Qbs). Bay side sands directly underlie the younger bay mud in Borings 6-1, 6-2, 6-3, and 6-7, with thicknesses ranging from two to eight feet. This material was also encountered in Boring 6-12 beneath the artificial fill with a thickness of at least 19 feet. It is composed of clean, silty, and clayey sand (SP, SM, SC) that is typically light brown to black, fine to medium grained, dense to very dense, and saturated. Bay side sands will be encountered in the excavation for the pump station, but will not be encountered in the excavation for any of the pipes (see Plates 2.1 through 2.4).

Older Bay Mud (Qob). The older bay mud was found to occur beneath the bay side sands in Borings 6-1, 6-2, and 6-3, with a maximum thickness of 25 feet in Boring 6-3. The material comprises a gray to light brown, medium stiff to hard, saturated, overconsolidated, slightly to highly plastic, silty to sandy clay (CL, CH) with gravel. It will probably be encountered in the base of the excavation for the pump station and reservoir (see Plate 2.4).

Colluvium/Alluvium (Qsr). Deposits of colluvium/alluvium were encountered beneath the younger bay mud in Boring 6-6 and between the artificial fill and bedrock in Boring 6-10. They consist of 10 to 18 feet of loose, gray, sandy to clayey gravel (GP, GC) and light brown, stiff, sandy clay (CL) with lenses of clean and clayey sand (SP, SC). These materials are not expected to be encountered during construction of the proposed facilities.

Sandstone (KJss). Sandstone was observed in outcrop along Illinois Street and in Boring 6-10 at a depth of 32 feet below ground surface. Within the boring, the sandstone is yellow-brown, moderately strong, moderately fractured, and hard. Core recovery averaged 80 percent with Rock Quality Designation (RQD) values of 0 to 50 percent. This material may be encountered in the excavation for the 18-inch pipe along Illinois Street (see Plates 2.1 and 2.2).

Shale (KJsh). In Boring 6-1, shale was encountered at a depth of 45 feet below ground surface. The material is green-black, weak, and moderately weathered. It may be encountered at the base of the pump station excavation.

Greenstone (KJg). Greenstone was encountered in Boring 6-2 at a depth of 60 to 74 feet below ground surface. Within the boring, it is brown to black and extremely weathered, consisting of gravel size pieces of hard greenstone in a sandy clay matrix. No greenstone should be encountered in the proposed excavations.

Chert and Cataclasite (KJc, KJu). Chert and cataclasite were observed in outcrop (see Plate 1), but were not encountered in any borings. The chert is red-brown and highly fractured, while the cataclasite is black, weak, and composed primarily of sheared shale. These materials may occur in the excavation for the 18-inch pipe along Illinois Street.

Serpentinite (spl, sp2). Serpentinite is the predominant bedrock material in the Fort Point-Hunters Point shear zone and it underlies most of the MTSF. The material was encountered in outcrop and in Borings 6-2, 6-3, 6-8, and 6-13 at depths of 74, 70, 41, and 3 feet below ground surface, respectively.

The serpentinite is light green, soft to hard, and weak to strong. It is usually crushed or sheared (spl) but locally may be composed of hard or fractured rock (sp2) enclosed within a matrix of soft, talcose material.

The weaker spl serpentinite varies from soft to moderately hard and weak to moderately strong. Spl is often sheared to a soft, friable material composed of sand and gravel sized fragments in a low plasticity matrix (refer to the log of Boring 6-13). This material typically softens with water contact and shrinks and fissures with air drying. In other instances the spl serpentinite occurs as slickensided, shattered, gravel to cobble sized blocks in a talcose matrix. The more competent sp2 serpentinite is dark green to black, hard, strong, and often occurs as fractured boulder sized inclusions within spl serpentinite.

RQD values for spl are typically zero, although local increases occur where hard, unfractured, one- to two-foot boulders exist. The average unconfined compressive strength of spl as determined by point load testing is 5,510 pounds per square inch (psi). These materials will be encountered in the excavation for the 18-inch pipe along Illinois Street.

Gabbro (gb). Gabbro occurs in outcrop as an inclusion within the spl serpentinite near Twenty-second Street (see Plate 1). The material is moderately hard, moderately weathered, and highly fractured. It may occur as inclusions within the serpentinite in the excavation for the 18-inch pipe along Illinois Street.

## GROUND WATER

Ground water occurs under unconfined conditions near the ground surface in the vicinity of the MTSF. Although artesian conditions were not observed in the exploratory borings, the presence of permeable bay side sands overlain by relatively impermeable younger bay mud suggests that these conditions may exist locally. As measured during the winter and spring of 1981-1982, ground water levels range from 4 to 15 feet below ground surface in Borings 6-13 and 6-10, respectively. Based on these measurements, the ground water level will be above the base of all excavations for the proposed facilities (see Plates 2.1 through 2.4).

## FAULTS

The MTSF lies entirely within the Fort Point-Hunters Point shear zone. Data summarized in the Geotechnical Reference Report suggest that this shear zone is part of the Late Cretaceous to Early Tertiary Coast Range thrust fault (60 to 70 million years old). This fault was apparently responsible for juxtaposition of the Franciscan Formation and Great Valley sequence 60 to 70 million years ago and shows no evidence of more recent activity.

In addition to the Fort Point-Hunters Point shear zone, the San Francisco Peninsula contains a number of active, potentially active, and inactive faults which may indirectly impact the MTSF. All of these faults lie west of the proposed structures, and from east to west include the Diamond Heights fault, the City College fault zone, the San Bruno fault, and the San Andreas fault.

The City College fault zone, like the Fort Point-Hunters Point shear zone, is thought to be part of the older Coast Range thrust (see the Geotechnical Reference Report). The Diamond Heights fault, recognized by apparent offset of bedrock contacts, trends north to northwest and occupies several aligned topographic saddles on the eastern face of Diamond Heights. The San Bruno fault has the same north to northwest trend and offsets sediments of the Colma Formation of Pleistocene age. Both may comprise minor elements of the extensive San Andreas fault system which dominates the tectonic framework of the San Francisco area. The main strand of this system, the San Andreas fault, lies only eight miles southwest of the MTSF and it has a long historic record of earthquake activity. Other major components of the San Andreas system in the Bay Area include the Seal Cove-San Gregorio fault 17 miles southwest of the MTSF and the Hayward-Calaveras fault system located 11 miles to the northeast.

SEISMICITY

The Geotechnical Reference Report discusses the absence of evidence for recent surface displacement or seismic activity on both the Fort Point-Hunters Point shear zone and the City College fault zone. Latest movement on these faults appears to predate even the oldest of the Pleistocene sediments overlying the bedrock.

Conversely, while no documented offset has been recorded on either the San Bruno fault or the Diamond Heights fault, the presence of fault related geomorphic features associated with the Diamond Heights fault (discussed in the Geotechnical Reference Report) and the offset at depth of the Pleistocene Colma Formation by the San Bruno fault (recorded by seismic reflection survey) suggests that both are potentially active.

Finally, the San Francisco Bay Area is a region of high seismic activity. Known fault systems displaying historic movement include the San Andreas fault, the San Gregorio-Seal Cove fault, and Hayward-Calaveras fault zone. Their activity and the potential damage resulting from major earthquakes on these faults are discussed in detail in the Geotechnical Reference Report.

## CONCLUSIONS AND RECOMMENDATIONS

### 1.0 PROJECT FEASIBILITY

Based on the exploration, laboratory testing, and geotechnical analyses performed, it is feasible to construct the MTSF as proposed, provided the recommendations presented in this report are considered in the project design.

The major geotechnical considerations for the facility are support of the temporary excavations, support of the pipes in the heterogeneous artificial fill, and installation of the pipe by jacking or augering beneath two intersections. The seismicity of the San Francisco Bay Area will also be an important consideration in design of the structures.

### 2.0 SEISMIC DESIGN CONSIDERATIONS

2.1 Maximum Credible Earthquake. A maximum credible earthquake is the largest earthquake that a given fault appears capable of generating. The maximum credible earthquake that could affect the MTSF would be one of Richter Magnitude 8.3 occurring approximately eight miles southwest of the facility on the San Andreas fault. On the basis of correlations between distance from a causative fault and peak bedrock accelerations (Schnabel and Seed, 1972), it has been determined that the maximum credible earthquake would produce a peak bedrock acceleration on the order of 0.52 gravity (g). Peak ground surface accelerations in the soil deposits overlying bedrock would be in the range of 0.28g (Seed, et. al., 1975). The maximum credible earthquake would have a predominant period of approximately 0.4 seconds in bedrock and 0.5 to 1.5 seconds in soil.

2.2 Design Earthquake. As established in the Geotechnical Reference Report, the average return interval of an earthquake of Richter Magnitude 8.3 on the northern section of the San Andreas fault is approximately 230 years. With an assumed 50-year design life for the facility, the maximum credible earthquake has a relatively low probability of occurrence. It is therefore recommended that a design earthquake of Richter Magnitude 7.0 displaying a return interval of approximately 50 years, and occurring eight miles from the facility on the San Andreas fault be used for design purposes.

The design earthquake would produce a maximum bedrock acceleration of 0.42g, peak ground surface accelerations in soil of 0.25g, and maximum velocities of 10 inches per second in bedrock and 12 inches per second in soil. It would have a predominant period of about 0.3 seconds in bedrock and 0.3 to 1.5 seconds in soil.

2.3 Fault Rupture. No active faults are known to cross the sites or alignments of the MTSF. Therefore, the potential risk of damage to the proposed facility due to rupture along an active fault is minimal.

2.4 Liquefaction. The liquefaction potential of granular soils along the proposed alignment has been evaluated by use of the "Simplified Procedure" as suggested by Seed and Idriss (1971). The results indicate that liquefaction is likely within zones of artificial fill and unlikely within bay side sands and colluvium/alluvium. Liquefaction of the artificial fill could result in significant ground movements, damaging the proposed pipelines.

2.5 Lateral Spreading. Lateral spreading of the artificial fill may occur as a result of the design earthquake. Ground movement of this type was the cause of nearly all major pipeline breaks during the 1906 San Francisco earthquake (Youd and Hoose, 1978), and provisions should be made to allow for repair of damaged pipes if similar events should occur in future earthquakes.

2.6 Seismically Induced Strain. Underground structures may be damaged by seismic ground shaking or vibration, even though an actual fracture or slip of the ground surface does not occur. The axial and bending strains induced in a pipeline by ground shaking can be estimated from the following equations (Newmark, 1967):

$$\text{Axial Strain } (\epsilon) = V/V_p \text{ and} \qquad (1)$$

$$\text{Bending Strain } (1/R) = A/V_s^2 \qquad (2)$$

Where:

| | | |
|---|---|---|
| $\epsilon$ | = | Axial strain of the pipe in feet per foot |
| $V$ | = | Maximum ground velocity in feet per second |
| $V_p$ | = | Compressional wave velocity in feet per second |
| $1/R$ | = | Curvature of the pipe in radians per foot |
| $A$ | = | Maximum ground acceleration in feet per second squared |
| $V_s$ | = | Shear wave velocity in feet per second |

For the design earthquake of Richter Magnitude 7.0 occurring along a nearby section of the San Andreas fault, the following values may be used:

| | | |
|---|---|---|
| $V$ | = | 0.83 feet per second (10 inches per second) in rock,<br>1.0 feet per second (12 inches per second) in soil |
| $A$ | = | 0.42g in rock,<br>0.25g in soil |
| $V_p$ | = | 7,500 feet per second in rock,<br>4,700 feet per second in soil |
| $V_s$ | = | 5,000 feet per second in rock,<br>1,000 feet per second in soil |

Using these values with equations (1) and (2) yields the strains presented in Table 1 - Seismically Induced Pipe

Strain During the Design Earthquake. The MTSF should be designed to accommodate the seismically induced strain caused by ground shaking shown in Table 1.

TABLE 1
SEISMICALLY INDUCED PIPE STRAIN DURING THE DESIGN EARTHQUAKE

| Pipe Location | Axial Strain (feet/foot) | Bending Strain (radians/foot) |
|---|---|---|
| Rock | $1.1 \times 10^{-4}$ | $0.5 \times 10^{-6}$ |
| Soil | $2.1 \times 10^{-4}$ | $8.0 \times 10^{-6}$ |

2.7 Seismic Earth Pressures. The increase in earth pressures due to the design earthquake has been estimated using the procedures suggested by Seed and Whitman (1970) for earth retaining walls. A rectangular pressure distribution of 16 pounds per cubic foot (pcf) times the height of the buried wall can be used for design in soil.

## 3.0 PIPE DESIGN

3.1 General. Ninety-six-, 72-, and 18-inch diameter pipes will be installed by the cut-and-cover method in trenches up to 21 feet deep, and by jacking or augering beneath the Illinois and Twenty-third Streets intersection and beneath Third Street.

External loads on the pipe will include loads due to the overlying earth materials, loads due to construction activities, traffic loads, loads due to nearby structures, and earthquake induced loads. It is recommended that the pipes be designed to resist the imposed loads with a minimum factor of safety of 1.5 and/or an acceptable amount of deflection as recommended by the manufacturer.

3.2 Settlements. Although no long-term settlement data is available for the area, data from other areas in San

Francisco indicate that continuing areal settlement may be occurring due to consolidation of the younger bay mud under the weight of the artificial fill. The magnitude of the future settlement is unknown. In addition to the continued areal settlement, the pipe and its backfill will impose loads on the younger bay mud resulting in additional consolidation settlement if the pipe is founded above the younger bay mud.

Settlements will also occur as a result of construction activities. The magnitude of the construction induced settlements will be dependent on the actual soil conditions encountered, the depth of excavation, and the construction method employed.

Differential settlements will occur between pipes supported within the artificial fill and the existing pile-supported structures, the proposed pump station and reservoir, and pipes supported on rock. The magnitude of the differential settlement may be on the order of 2 inches over 200 feet along the pipeline, and on the order of 2 inches at the connection between pipes and new or existing structures. Pipes and connections should be designed to accommodate the differential settlement unless they are supported on pile foundations.

3.3 Pile Foundations. To avoid differential settlement, pipes may be founded on end bearing piles which extend into the dense bay side sands or bedrock. For preliminary design purposes, the piles may be assumed to be approximately 12 inches in cross-section and 50-ton vertical capacity.

Pile lengths will vary depending on pile type, capacity, and location. For estimating purposes, the piles may be assumed to extend about 10 feet into the dense bay side sands or five feet below the bedrock surface shown on Plates 2.1 through 2.4. It is recommended that pilot piles be driven along the alignment prior to final design and construction in order to determine actual pile capacity and required lengths.

## 3.4 Earth Loads

3.4.1 Pipes Supported on Piles. Pipes supported on piles should be designed to resist full overburden pressures and downdrag loads as a result of the continuing settlement of the younger bay mud. Overburden pressures may be calculated as the pressure exerted by a fluid weighing 125 pcf above ground water level and 63 pcf below ground water level. Downdrag loads can be taken as 400 psf acting on vertical planes extending from the ground surface to the springline of the pipe and on the surface of that portion of the pile which is above the base of the younger bay mud.

3.4.2 Pipes Supported on Soil or Rock. Loads on the pipe due to the overlying soil will be dependent upon the construction method, the depth of placement, the backfill type and placement, and the type of pipe.

Pipes will either be placed in narrow trenches with vertical sides, or will be jacked or augered into place. No major fill is contemplated above the existing ground surface and the pipes placed by cut-and-cover construction will thus be in a "trench" condition. The earth load on pipes placed in trenches may be calculated using formulas developed by Marston (1930). For a rigid pipe in a "trench" condition, the formula is:

$$W_c = C_d w B_d^2 \tag{4}$$

Where: $W_c$ = Vertical load on the pipe in pounds per unit length

$C_d$ = An emperical coefficient described by Marston (1930)

$w$ = Unit weight of the trench backfill material in pcf

$B_d$ = Width of the trench at the top of the pipe in feet

When using this equation, the emperical coefficient, $C_d$, can be obtained from Figure 3 - Earth Load Coefficient, $C_d$, and the unit weight of the trench backfill, w, can be assumed as 130 pcf.

If the pipe is flexible and the pipe bedding is placed as recommended in this report, then the bedding and earth materials surrounding the pipe will carry a portion of the earth load and equation (3) can be modified to:

$$W_c = C_d w B_c B_d \tag{4}$$

Where: $B_c$ = Outside diameter of the pipe in feet

It is believed that most of the pipes will be placed in the "trench" condition. However, if the width of the trench is greater than twice the diameter of the pipe, then the pipe may be in an "embankment" condition and equations (3) and (4) will not apply. The earth load should then be calculated on the basis of Marston's formula for "embankment" conditions (Marston, 1930).

Pipes installed by jacking or augering should be designed to resist the pressures exerted by the overlying earth materials. The pressure exerted by the overlying earth materials may be assumed equal to the pressure exerted by a fluid weighing 130 pcf above the ground water level and 68 pcf below the ground water level.

3.5 Surcharge Pressures. The pipes will be subject to surcharge pressures due to construction activities, traffic, and the overlying railroad tracks. Pressures on the pipe may be estimated with Figure 4 - Vertical Surcharge Pressures.

3.6 Modulus of Soil Reaction. Flexible and semi-rigid pipes are typically designed to withstand a certain amount of deflection from the applied earth loads. These deflections can be estimated with the aid of equations developed by

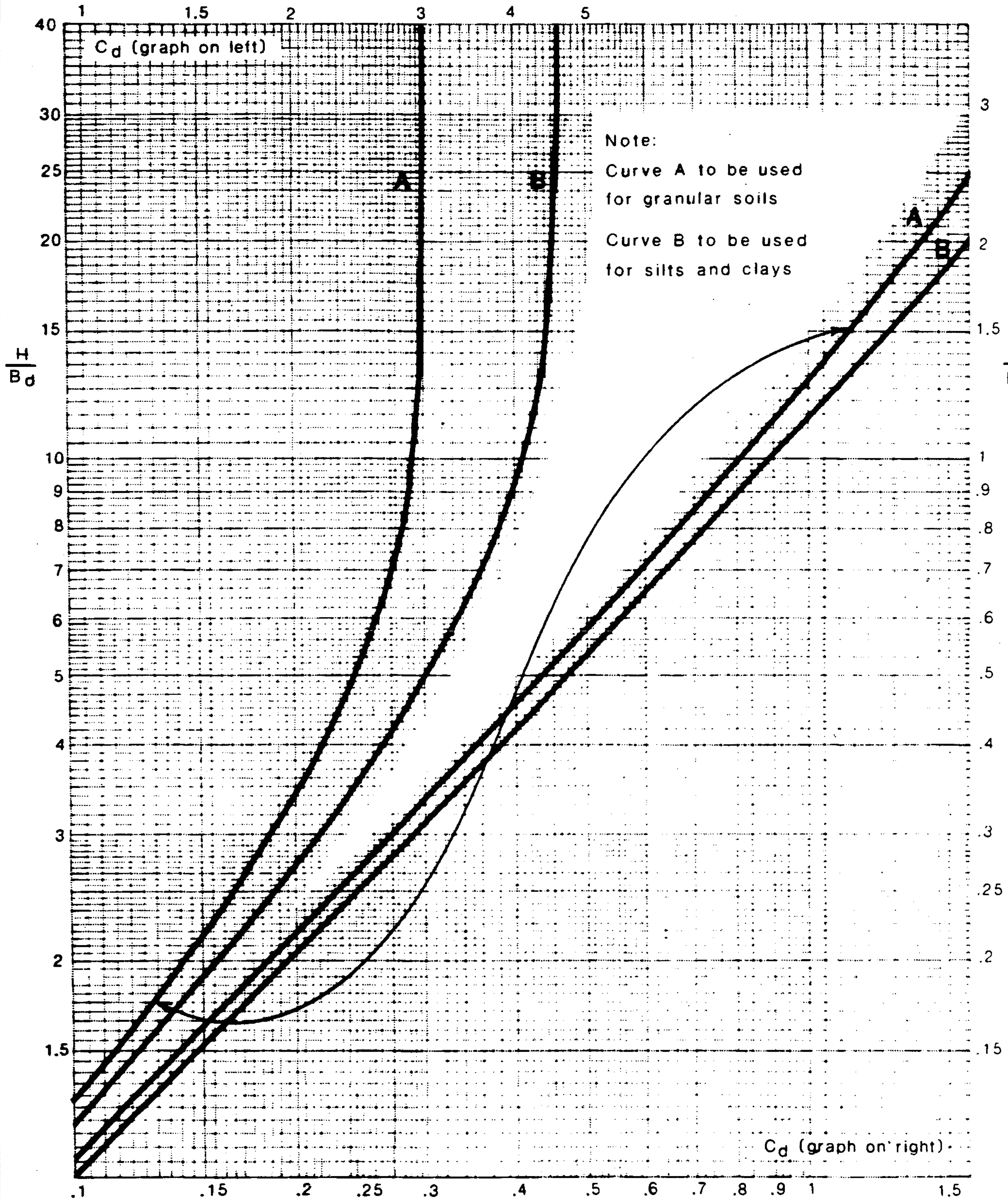
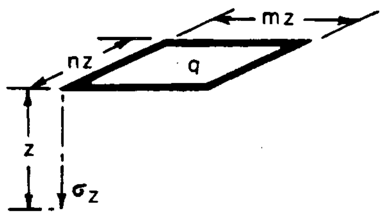



**Fig. 3**
**Earth Load Coefficient $C_d$**

CALDWELL-GONZALEZ-KENNEDY-TUDOR
A JOINT VENTURE




$\sigma_z = I_r\, q$

Where:

$\sigma_z$ = Vertical pressure at depth z (pounds/foot$^2$)

$I_r$ = Influence value

q = Surcharge pressure at ground surface (pounds/foot$^2$)

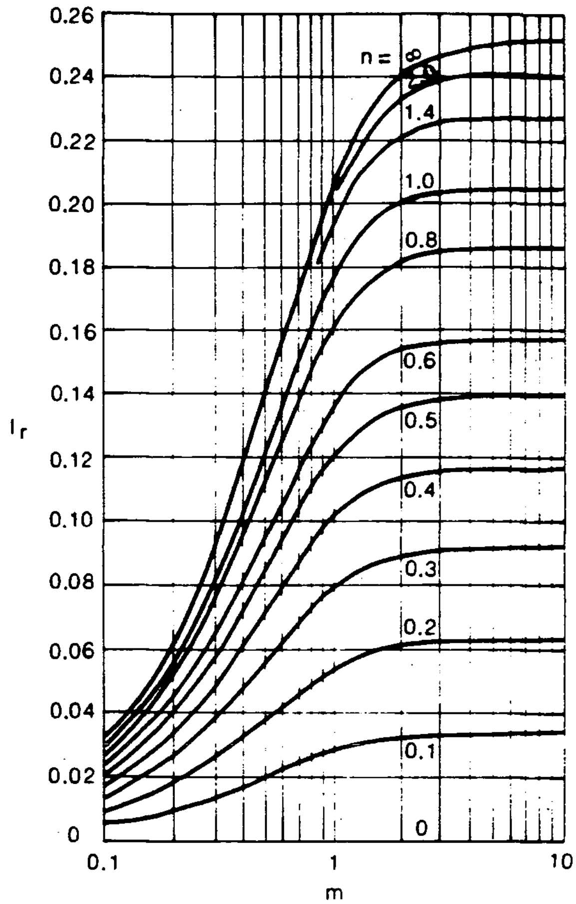



**Fig. 4**
**Vertical Surcharge Pressures**

Spangler (1941). The modulus of soil reaction used in these equations has been estimated for the soil and rock types present along the MTSF alignments and for the recommended bedding materials. A modulus of soil reaction of 100 pounds per square inch (psi) can be assumed for pipe supported in artificial fill. For pipes supported in rock, a modulus of soil reaction of 1,000 psi may be assumed.

3.7 Thrust Resistance. Where the proposed pipelines change direction abruptly, resistance to thrust forces can be provided by mobilizing frictional resistance between the pipe and surrounding soil, by the use of a thrust block, or by a combination of the two.

The frictional resistance can be calculated utilizing coefficients of friction between the pipe and adjacent backfill of 0.40 for concrete pipe and 0.30 for steel pipe. Pipe segments may be connected by tension joints capable of transmitting the required thrust forces if more than one segment of pipe is needed.

Passive resistance at a thrust block may be used instead of, or in conjunction with, frictional resistance to resist pipe thrust. The resistance provided can be calculated utilizing an equivalent fluid pressure of 190 pcf above the water table and 95 pcf below the water table. These low values are dictated by the loose and inhomogeneous nature of the soils and are intended to keep the resulting deflections minimal.

## 4.0 PUMP STATION AND RESERVOIR DESIGN

4.1 General. The pump station and reservoir facility will be constructed in a 35- to 45-foot deep excavation, and will be founded on dense to very dense sand and medium stiff to hard clay overlying bedrock. The excavation will extend through the artificial fill and younger bay mud into the bay side sands and older bay mud, and ground water level is near the ground surface (see Plate 2.4).

4.2 Foundation Design. The weight of the proposed structure will be less than the weight of the excavated soil, but the continuing areal settlement of the younger bay mud will cause downdrag loads on the structure. Downdrag loads may be calculated as 400 pounds per square foot (psf) acting on vertical planes extending from the ground surface to the base of the younger bay mud on all sides of the structure.

The structure as presently proposed may be supported on structural backfill over dense bay side sands by a structural slab-on-grade in combination with spread footings. An allowable bearing capacity of 3,500 pounds per square foot (psf) for either the slab-on-grade or spread footings can be assumed for design purposes, and the modulus of subgrade reaction can be assumed as 120 tons per cubic foot. Settlement under the anticipated loads is estimated to be less than one inch.

4.3 Uplift Resistance. Uplift forces on the pump station and reservoir created by buoyancy may be resisted by incorporating an adequate mass in the concrete walls and slab of the structure, by utilizing the weight of the structural fill above slab collars and above the reservoir, and by tension cables anchored into the underlying bedrock or tension piles into the older bay mud.

The buoyant weight of the soil above slab collars and above the reservoir may be assumed as 60 pcf, while the non-buoyant weight may be assumed as 125 pcf. Additional resistance to uplift will be provided by the shear capacity of the soils directly above the edge of the collar. Within the artificial fill and bay side sands, this shear capacity may be considered equal to the at-rest lateral earth pressure on the shear plane times two-thirds the tangent to the friction angle of soil, as expressed by the formula:

$$R_\phi = \sigma_{oh} \; (2/3 \, \tan\phi) \qquad (5)$$

Where: $R_\phi$ = Available shear capacity in psf
$\sigma_{oh}$ = At-rest lateral earth pressure in psf
$\phi$ = Angle of internal friction of the structural backfill

The at-rest earth pressure ($\sigma_{oh}$) may be considered equal to the pressure exerted by a fluid weighing 60 pcf above the water table and 30 pcf below the water table. Tan$\phi$ may be assumed as 0.7. Within the younger and older bay mud, the shear capacity may be assumed as 400 psf and 1,000 psf, respectively, acting on the shear plane. The uplift resistance provided by the shear capacity of the soils above the collar should not exceed 20 percent of the total uplift resistance of the pump station and reservoir facility.

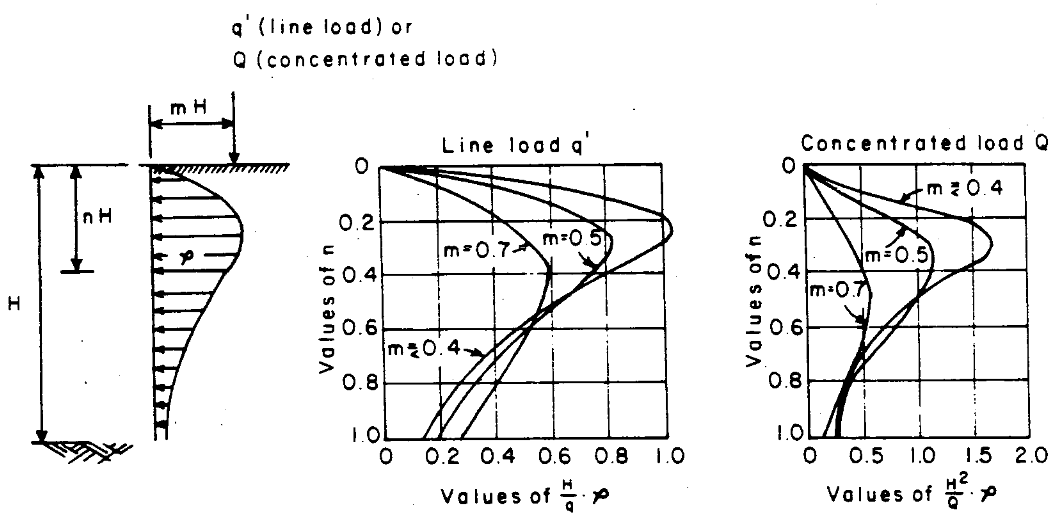
Rock anchors and tension piles should be placed no closer than 10 feet on center. For preliminary design, the ultimate capacity of rock anchors can be calculated using a bond strength of 2,000 psf between bedrock and high strength cement grout, and the ultimate pullout capacity of 10-foot long, 12-inch square piles can be estimated as 20 kips. For final design, full scale field testing should be performed to evaluate the actual capacity of rock anchors and tension piles. An adequate factor of safety chosen by the designer should be applied to all the uplift resistance values presented.

4.4 Lateral Pressures. Permanent lateral pressures on the walls of the pump station and reservoir will include earth pressures from the adjacent structural backfill and hydrostatic pressures below the ground water level. Since the walls of the facility will be rigid and restrained, at-rest earth pressures will develop.

The at-rest pressure exerted by structural backfill materials may be assumed equal to the pressure exerted by a fluid weighing 60 pcf above the ground water level. Below the ground water level, the at-rest pressure exerted by the structural backfill and ground water may be assumed equal to the pressure exerted by a fluid weighing 90 pcf.

Lateral pressures due to surcharges at the ground surface should be included in the design and may be calculated with the aid of Figure 5 - Lateral Surcharge Pressures.

Fig. 5
Lateral Surcharge Pressures




## 5.0 EARTHWORK

5.1 **Excavation Characteristics**. Excavation of the soil overlying bedrock will be possible with the use of conventional grading equipment; however, the younger bay mud will be saturated, soft, and highly plastic, and will not support heavy construction equipment.

Based upon the results of seismic refraction surveys performed for Element 3, Islais Creek Transport/Storage Facility and Element 5, Channel-Islais Transport Facility (Caldwell-Gonzalez-Kennedy-Tudor, 1982), the serpentinite may require blasting. However, because of the sheared and broken nature of the material as observed in borings and outcrops, much of the bedrock can probably be removed by ripping.

5.2 Foundation Preparation. Where the foundation for the pump station and reservoir will be placed on an excavated soil surface, all younger bay mud should be removed. This may require overexcavation of several feet beneath portions of the reservoir. The exposed surface should be scarified to a depth of six inches and recompacted to a minimum relative compaction of 95 percent as determined by standard test method ASTM D1557. Structural backfill may be placed if required to raise the grade of the bottom of excavation.

5.3 Structural Backfill. Compacted structural backfill should be placed adjacent to and beneath the proposed pump station and reservoir to provide support and to restore the excavated surface to the proper grade. On-site earth materials (with the exception of the younger bay mud) should be suitable provided that they are free of organics and other deleterious materials, that they have a liquid limit less than 35 percent and a plasticity index less than 12 percent, that not more than 25 percent of the material by weight is finer than the No. 200 sieve, and that the maximum particle size is 4 inches or less. The materials may be blended, screened, and/or crushed to meet these requirements, and imported materials which meet the above criteria are acceptable provided they are first approved by a qualified geotechnical engineer.

Unless otherwise recommended, all structural backfill should be placed in layers not to exceed 8 inches in loose thickness and compacted to a minimum relative compaction of 90 percent as determined by standard test method ASTM D1557. Material placed beneath the proposed structure or within three feet of ground surface should be compacted to 95 percent relative compaction. If the space between the sides of the excavation and the structure is too small for adequate compaction of natural soils, pea gravel or clean sand may be used as structural backfill and may be vibrated into place.

5.4 Pipe Bedding. All pipes placed within trenches should be completely surrounded with bedding to provide uniform support and protection. Bedding may consist of medium to coarse grained sand, pea gravel, or crushed rock of less than 1-1/2 inch size. The material should contain less than three percent by weight passing the No. 200 sieve. Where pipes are to be placed within the artificial fill, sand should not be used as bedding because it may be subject to migration into the surrounding porous fill, leaving the pipe unsupported. Well graded crushed stone and gravel have less tendency to flow and are most effective for stabilizing trench bottoms. Such materials will likely be the best choice for pipe bedding.

Pipe bedding should be placed with a minimum thickness of six inches over the top of all pipes. Beneath all pipes, pipe bedding should be placed with a thickness of six inches over rock and one-third the diameter of the pipe (but not less than one foot) over artificial fill. All bedding material should be placed carefully to achieve uniform contact with the pipe and a minimum relative compaction of 90 percent as determined by standard test method ASTM D1557.

Pipes installed by jacking or augering should be fully grouted so that all voids adjacent to the pipes are filled.

5.5 Trench Width. Minimum trench widths should be provided in order to ensure uniform support and to minimize external loads on the pipe. The width of the bedding, as measured from the side of the pipe to the side of the trench, should be a minimum of 12 inches for 96- and 72-inch rigid pipes and 6 inches for 18-inch rigid pipes. For flexible or semi-rigid pipes, the width of the bedding should be a minimum of 12 inches in rock and one-half the diameter of the pipe (but not less than 12 inches) in artificial fill. If the pipes are placed adjacent to an existing underground structure, a minimum separation of one-half the pipe diameter should be maintained.

5.6 Trench Backfill. Trench backfill may consist of excavated on-site soils provided they are free of organics and debris, have been screened to remove particles larger than 6 inches in diameter, have a liquid limit less than 35 percent and a plasticity index less than 12 percent, and have been properly blended and dried to near optimum moisture content. Imported fill may also be used provided that the material meets the above requirements and is approved by a qualified geotechnical engineer prior to placement.

Trench backfill should be placed in layers not exceeding 8 inches in uncompacted thickness and should be compacted to 90 percent relative compaction as determined by standard test method ASTM D1557. The upper three feet of trench backfill should be compacted to 95 percent relative compaction in areas where traffic or structural loads are anticipated.

## 6.0 CONSTRUCTION CONSIDERATIONS

6.1 Pipe Jacking or Augering. The 18-inch pipe will be jacked or augered through the artificial fill beneath the Illinois and Twenty-third Streets intersection and beneath Third Street. The artificial fill will be subject to caving above ground water level and running or ravelling below ground water level. In addition, obstructions such as wooden piles and concrete blocks may exist.

Passive earth pressure may be mobilized to provide thrust for the jacking or augering operation. The magnitude of the available passive earth pressure may be calculated using an equivalent fluid pressure of 300 pcf above the ground water level and 150 pcf below the ground water level.

6.2 Ground Water Control. As shown on Plates 2.1 through 2.4, the static ground water level is near ground surface along the alignment of the proposed facilities. Therefore, all excavations will require some form of ground water control.

Regardless of the type of dewatering system utilized, a properly designed, installed, and operated dewatering system should:

1. Lower the water table and intercept seepage which will emerge from the sides or the bottom of the excavation.
2. Improve the stability of the excavation side walls and prevent disturbance of the bottom of the excavation.
3. Provide a reasonably dry working area in the bottom of the excavation.

The design of the dewatering system should also provide for collection and removal of surface water and rainfall.

The amount of ground water flowing into the excavations is expected to vary depending on earth materials encountered. Ground water inflows will be minor for excavations which are entirely within the bedrock. Under these conditions, ground water control may consist solely of pumps placed at the base of the excavation.

For excavations within the surficial soils, dewatering will be difficult due to the highly permeable nature of the artificial fill and the proximity of San Francisco Bay.

During dewatering, it will be necessary to prevent lowering of the water table in surrounding areas. Otherwise, detrimental settlement may occur, possibly causing damage to existing structures.

To avoid the problems associated with dewatering, it is recommended that the excavations be isolated from the ground water by an impervious barrier such as steel sheet piling or a slurry trench. The barrier should extend into the underlying younger bay mud, older bay mud, or bedrock. Steel sheet piling will act as a ground water barrier only if it extends into an impermeable layer and maintains the interlock between sheets. If obstructions such as large boulders or timber piles are encountered during emplacement, the interlock may be lost and the sheet piling may not be an effective barrier to ground water inflows.

Because of the problems associated with driving sheet piles through the artificial fill and the presence of fractured and sheared bedrock within portions of the excavation, a combination of local dewatering and isolation may prove most effective. For example, interlocking steel sheet piling may be driven to isolate the excavation from the ground water. Where either the sheet pile interlock fails to retain the ground water, the sheared and fractured bedrock transmits ground water, or the seal to the underlying impermeable material is inadequate, well points and sump pumps may be used to alleviate local accumulation of ground water.

6.3 Cut Slopes. Temporary cuts in soil will require support at inclinations greater than 1-1/2 horizontal to 1 vertical. Because of the sheared and broken nature of the bedrock and the highly variable orientation of discontinuities, no definite judgement can be made at this time with regard to the stability of cut slopes. All cut slopes in rock steeper than 1 horizontal to 1 vertical should be fully supported unless an investigation conducted at the time of construction by a qualified geotechnical engineer or engineering geologist determines otherwise.

6.4 Temporary Earth Pressures. The use of sloping sides in the excavations is precluded by space limitations and the presence of adjacent structures and utilities. Excavations will therefore require a shoring system for support.

Temporary, internally braced and shored excavations will be subjected to the generalized earth pressures depicted on Figure 6 - Lateral Pressures for Temporary Excavations. Lateral pressures due to surcharge loading should also be considered in design of the temporary bracing system (see Figure 5).

6.5 Excavation Base Stability. Stability of the base of trench excavations will be dependent on ground water control, the proximity of the soft younger bay mud to the excavation base, and the dimensions of the excavation. When the excavation is in granular materials, it is recommended that the ground water level be maintained a minimum of two feet beneath the bottom of the excavation throughout construction in order to avoid base failure due to high seepage gradients.

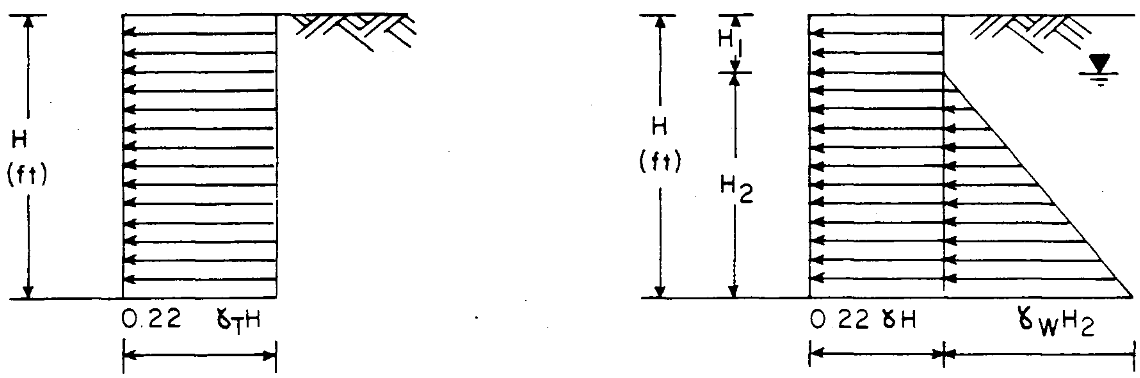
Analysis of the conditions expected at the pump station and reservoir site indicates that the factor of safety against basal heave may approach 1.0 for the planned excavation. Therefore, basal heave may occur and large movements of the support system and adjacent ground can be expected.

The actual magnitude of ground movement will be a function of support system stiffness, method of support installation, and soil stiffness. Using the method presented by Mana and Clough (1981), maximum lateral movements and maximum ground settlement are estimated to be on the order of one foot, and to extend laterally for a distance of about

a) Apparent Lateral Earth Pressures for Braced Excavations in Artificial Fill or Weathered Bedrock

1) Above Water Table

2) Below Water Table




Where $\gamma_T = 130$ pcf

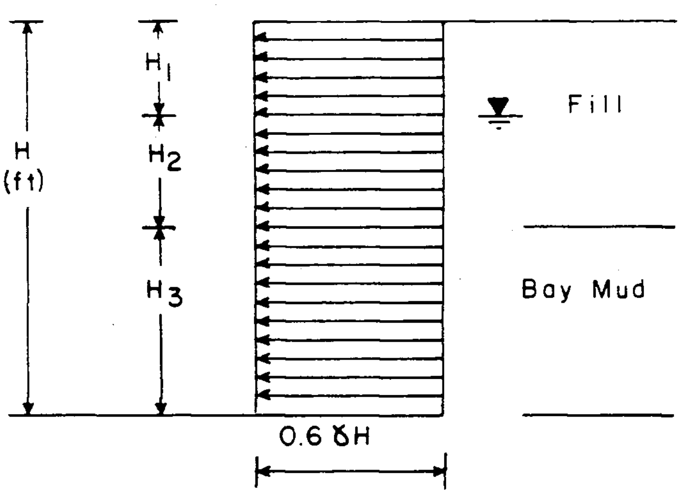
Where $\gamma = \frac{1}{H}(\gamma_T H_1 + \gamma_b H_2)$

$\gamma_T = 130$ pcf

$\gamma_b = 67$ pcf

$\gamma_W = 63$ pcf

b) Apparent Lateral Earth Pressures for Braced Excavations in Stratified Soils (Artificial Fill Over Bay Mud)




$\gamma = \frac{1}{H}(\gamma_T H_1 + \gamma_b H_2 + \gamma_m H_3)$

$\gamma_T = 130$ pcf

$\gamma_b = 67$ pcf

$\gamma_m = 95$ pcf

**Fig. 6**

**Lateral Pressures for Temporary Excavations**

CALDWELL-GONZALEZ-KENNEDY-TUDOR

A JOINT VENTURE

twice the depth of the excavation. The predicted levels of movement are for internally braced support systems constructed using what Mana and Clough describe as "average prudent construction procedures".

To minimize the potential for basal heave and to keep ground and support system movement to a minimum, the following are recommended:

1. Sheetpiles should be driven a minimum of five feet into firm soil or into bedrock beneath the younger bay mud.
2. Bracing struts and sheetpile walls should be as stiff as possible.
3. Bracing struts should be preloaded to 75 percent of their design load immediately after installation.
4. The first level of struts should be installed before the excavation reaches a depth of five feet.
5. The distance between the lowest level of struts and the base of the excavation should not exceed 10 feet when the base of the excavation is in younger bay mud.
6. No surcharge loading should be allowed at the ground surface within 20 feet of the edge of the excavation.

6.6 Pile Driving. It is recommended that piles be driven with followers prior to excavation to avoid surcharging the excavation. It may be desirable to predrill the piles through the heterogeneous artificial fill.

6.7 Construction Loads. Significant loads can be imposed on pipes and structures during backfilling operations. No heavy construction equipment should be allowed to operate within 2-1/2 feet of structures during backfilling operations.

## 7.0 CORROSION

Chemical analysis of samples of artificial fill, younger bay mud, and bay side sands taken from Borings 6-2, 6-10, and

6-12 indicates that the facilities may be placed in a corrosive environment. Damage to the structures and their foundations should be prevented by the use of protective coatings or other methods.

## 8.0 QUALITY CONTROL

The conclusions and recommendations presented in this report are based upon interpretation of subsurface conditions between widely spaced exploratory borings and outcrops. A qualified engineering geologist should be retained during construction to map geologic structure exposed in all cut slopes created as a result of excavation. Should subsurface conditions differ substantially from those presented herein, a qualified geotechnical engineer should review the above recommendations to determine their applicability in light of the new information.

All earthwork should be observed in the field by a qualified geotechnical engineer or his representative. Periodic density tests of structural backfill, pipe bedding, and trench backfill should be made to verify that construction is in conformance with the specifications and that proper densities are achieved.

It is further recommended that a qualified geotechnical engineer review the foundation design, excavation support systems, and ground water control schemes to determine conformance with the recommendations presented in this report.

## 9.0 CLOSURE

This report was prepared for the exclusive use of the San Francisco Clean Water Program's Bayside Facilities Planning Project. The findings, recommendations, and professional opinions presented herein are within the limits prescribed by the client and were prepared in accordance with generally accepted professional engineering and geologic practice. There is no other warranty either expressed or implied.

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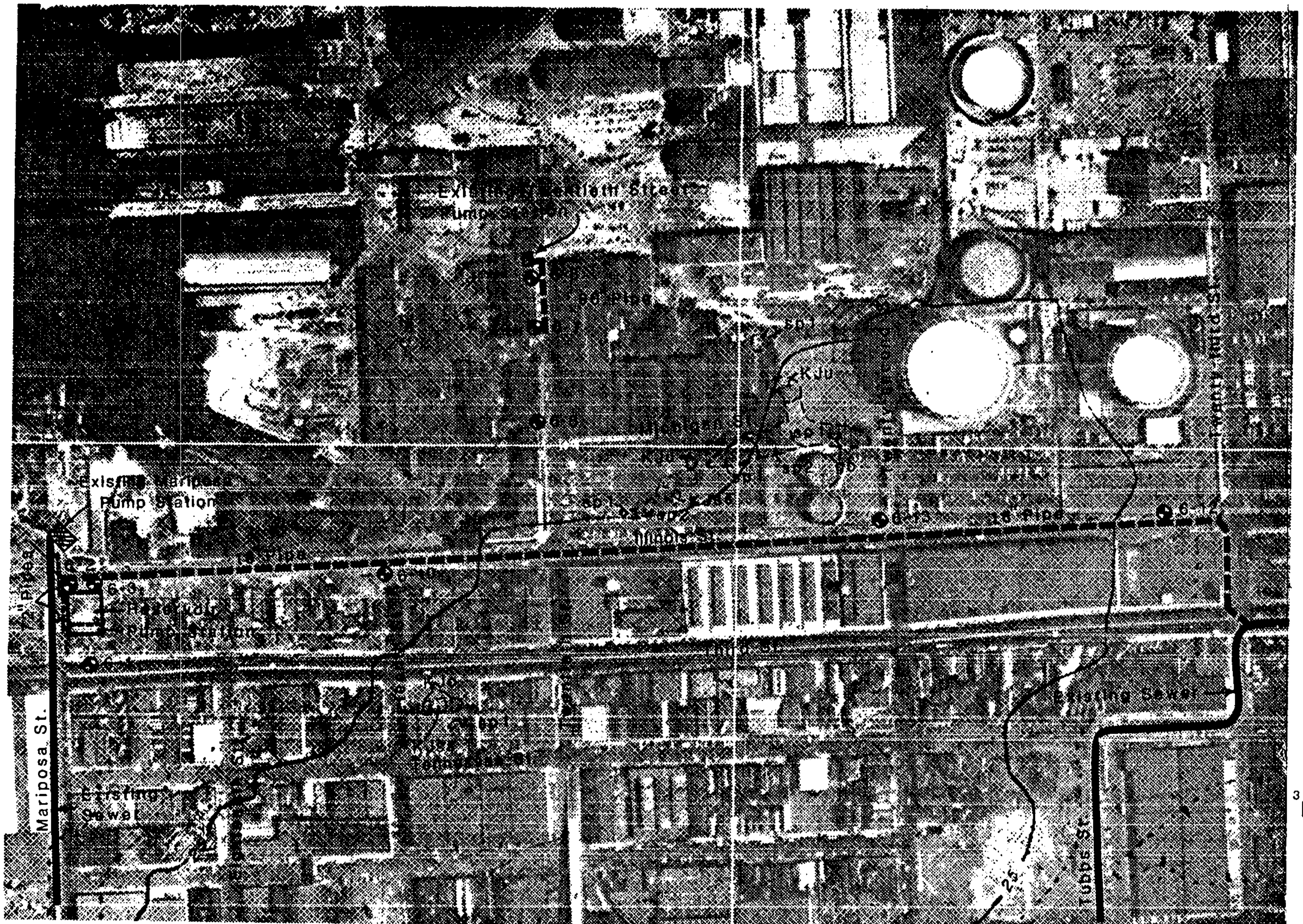


LEGEND

Proposed facilities

Existing facilities

6-1 Location of exploratory boring

Geologic contact

25 Contours of ground surface elevation (San Francisco City Datum)

FRANCISCAN FORMATION

| | |
|---|---|
| KJss | Sandstone |
| KJc | Chert |
| KJu | Cataclasite |

OPHIOLITE SEQUENCE

| | |
|---|---|
| sp1 | Serpentinite |
| sp2 | Serpentinite |
| gb | Gabbro |

300 0 300 600

APPROXIMATE SCALE IN FEET

**Plate 1 Site Plan**
**Mariposa Transport/Storage Facility**

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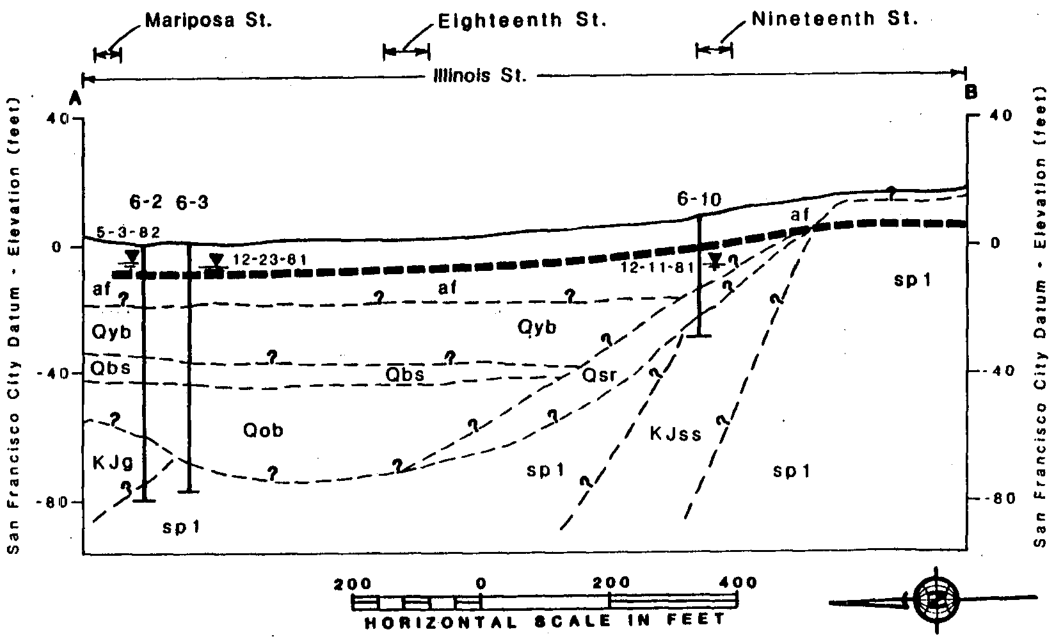



## LEGEND

| | |
|---|---|
| af | Artificial fill |
| Qyb | Younger bay mud, soft and highly plastic silty clay |
| Qbs | Bay side sands, poorly graded sand, silt, and clay mixtures |
| Qob | Older bay mud, stiff sandy clays |
| Qsr | Colluvium/Alluvium, clayey and sandy gravels |

**FRANCISCAN FORMATION**

| | |
|---|---|
| KJss | Sandstone |
| KJsh | Shale |
| KJg | Greenstone |

**OPHIOLITE SEQUENCE**

| | |
|---|---|
| sp1 | Serpentinite |

### SYMBOLS

- ---?--- Geologic contact - Dashed where approximately located, queried where uncertain.
- Proposed Pipes
- Proposed Pump Station and Reservoir
- Water level on date indicated
- 6-1 Location of exploratory boring

**Plate 2.1 Plan and Geotechnical Profile Proposed 18-Inch Pipe, Northern Section**

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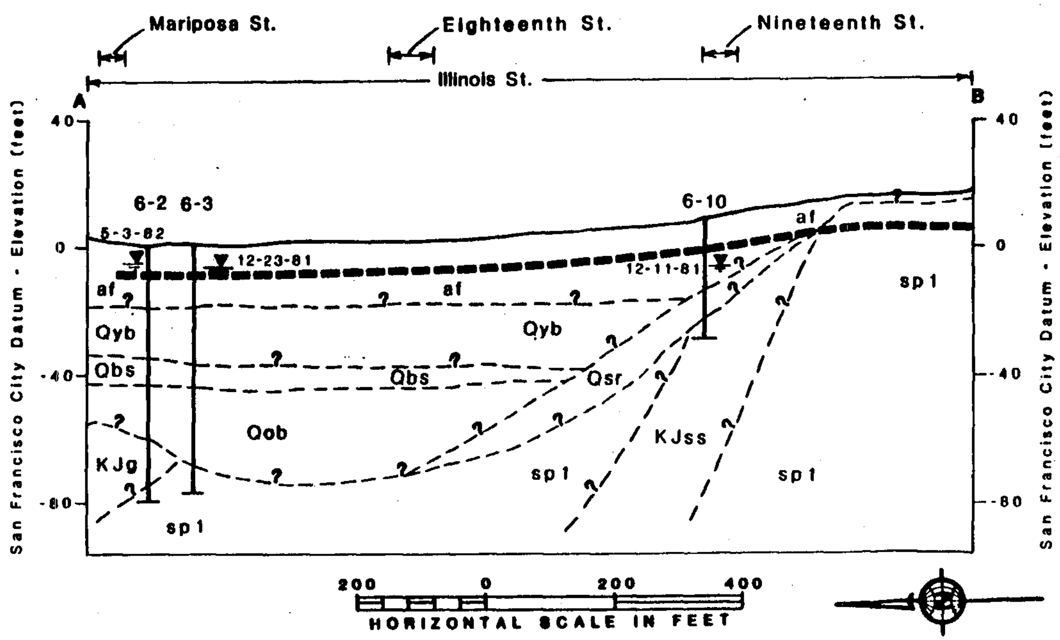



**LEGEND**

| | |
|---|---|
| af | Artificial fill |
| Qyb | Younger bay mud, soft and highly plastic silty clay |
| Qbs | Bay side sands, poorly graded sand, silt, and clay mixtures |
| Qob | Older bay mud, stiff sandy clays |
| Qsr | Colluvium/Alluvium, clayey and sandy gravels |

**FRANCISCAN FORMATION**

| | |
|---|---|
| KJss | Sandstone |
| KJsh | Shale |
| KJg | Greenstone |

**OPHIOLITE SEQUENCE**

| | |
|---|---|
| sp1 | Serpentinite |

**SYMBOLS**

- - - ? Geologic contact - Dashed where approximately located, queried where uncertain.

Proposed Pipes

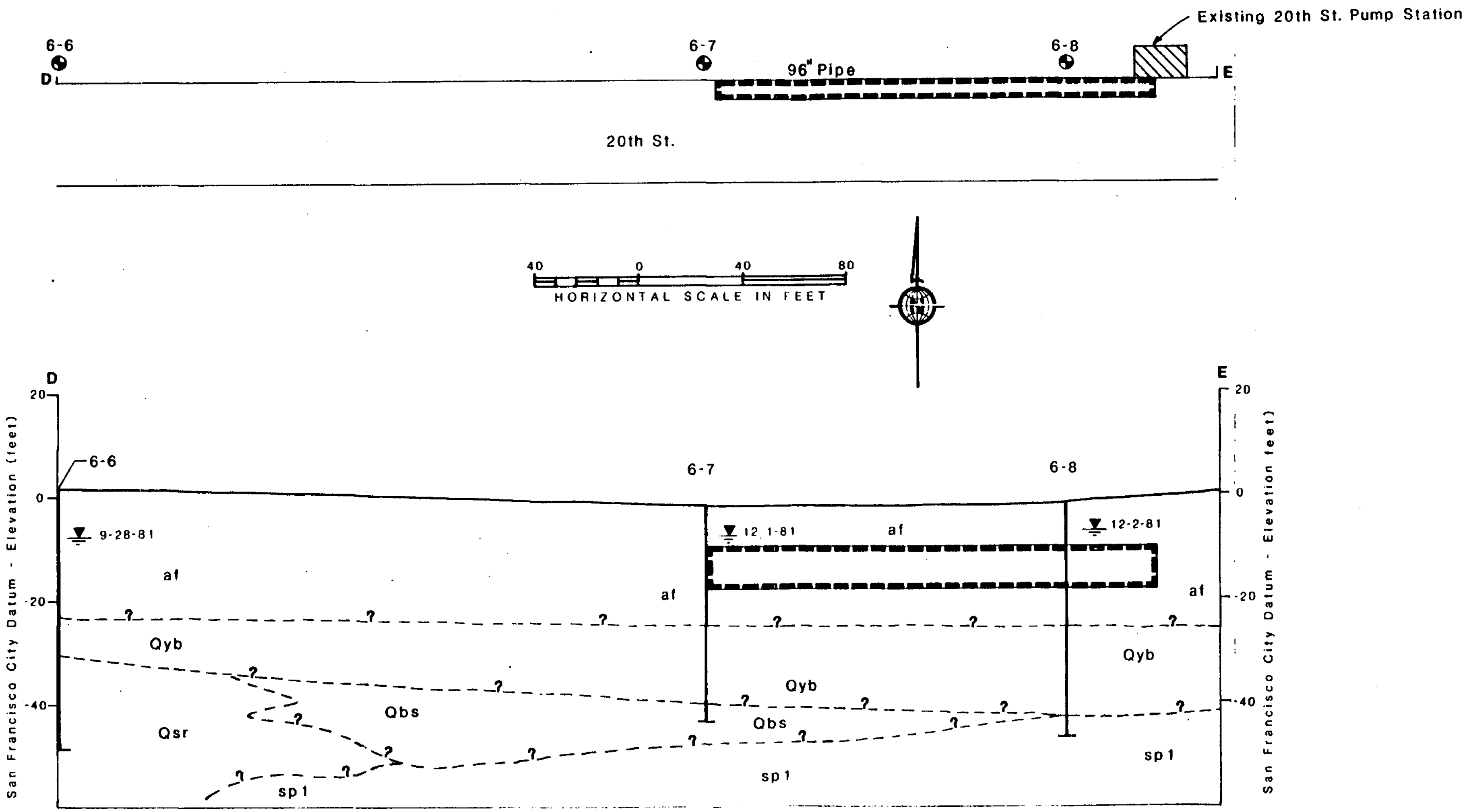
Proposed Pump Station and Reservoir

Water level on date indicated

6-1 Location of exploratory boring

**Plate 2.1 Plan and Geotechnical Profile Proposed 18-inch Pipe, Northern Section**

CALDWELL·GONZALEZ·KENNEDY·TUDOR
A JOINT VENTURE




Note: Legend on Plate 2.1

**Plate 2.3 Plan and Geotechnical Profile Proposed 96-Inch Pipe**

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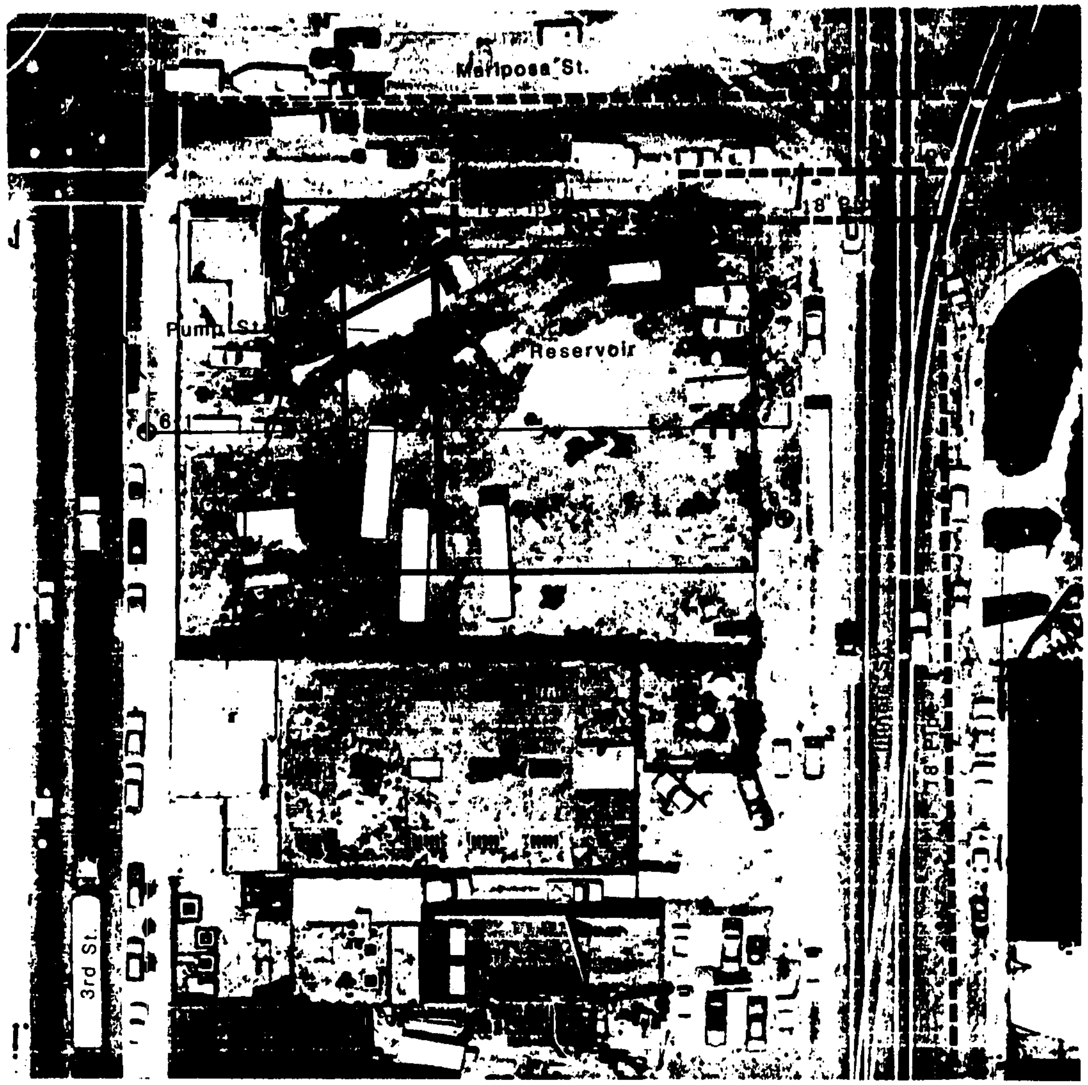


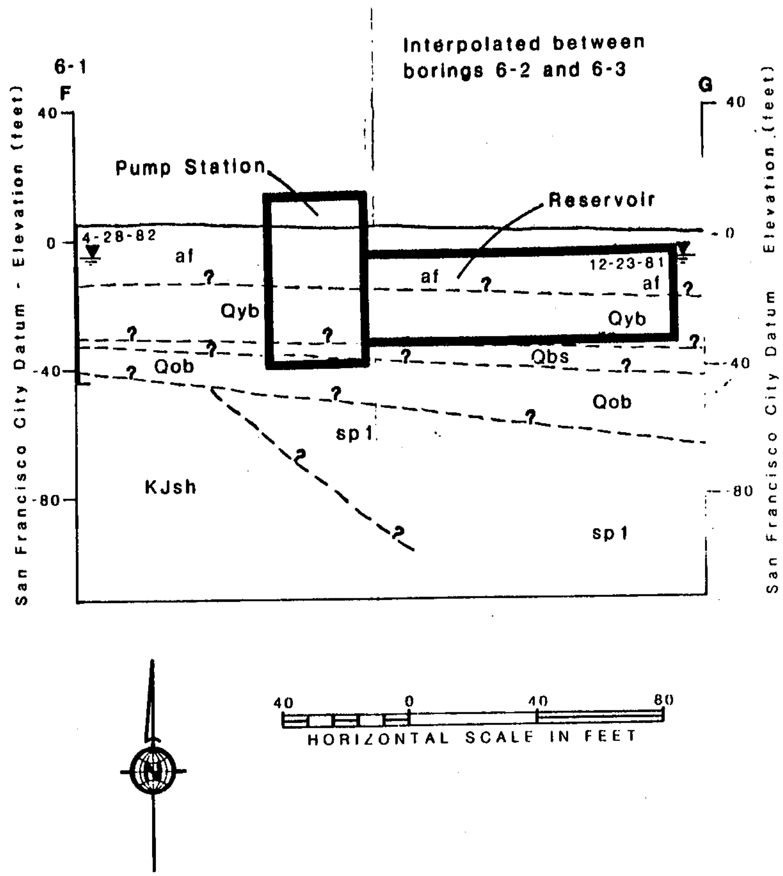


Note: Legend on Plate 2.1

**Plate 2.4 Plan and Geotechnical Profile Mariposa Pump Station and Reservoir**

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